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MAGAZINE

VOLUME 7 NUMBER 2
JANUARY 26, 1988

FIRST LOOKS: CHARLES PETZOLD'S HANDS-ON REVIEW OF IBM'S OS/2

Compaq Aces IBM Again!

PC Labs Tests 20-MHz Deskpro

Plus:

- Do-It-Yourself 386s
- 17 Add-ins for Spreadsheet Power
- 18 Ways to Share Your Laser

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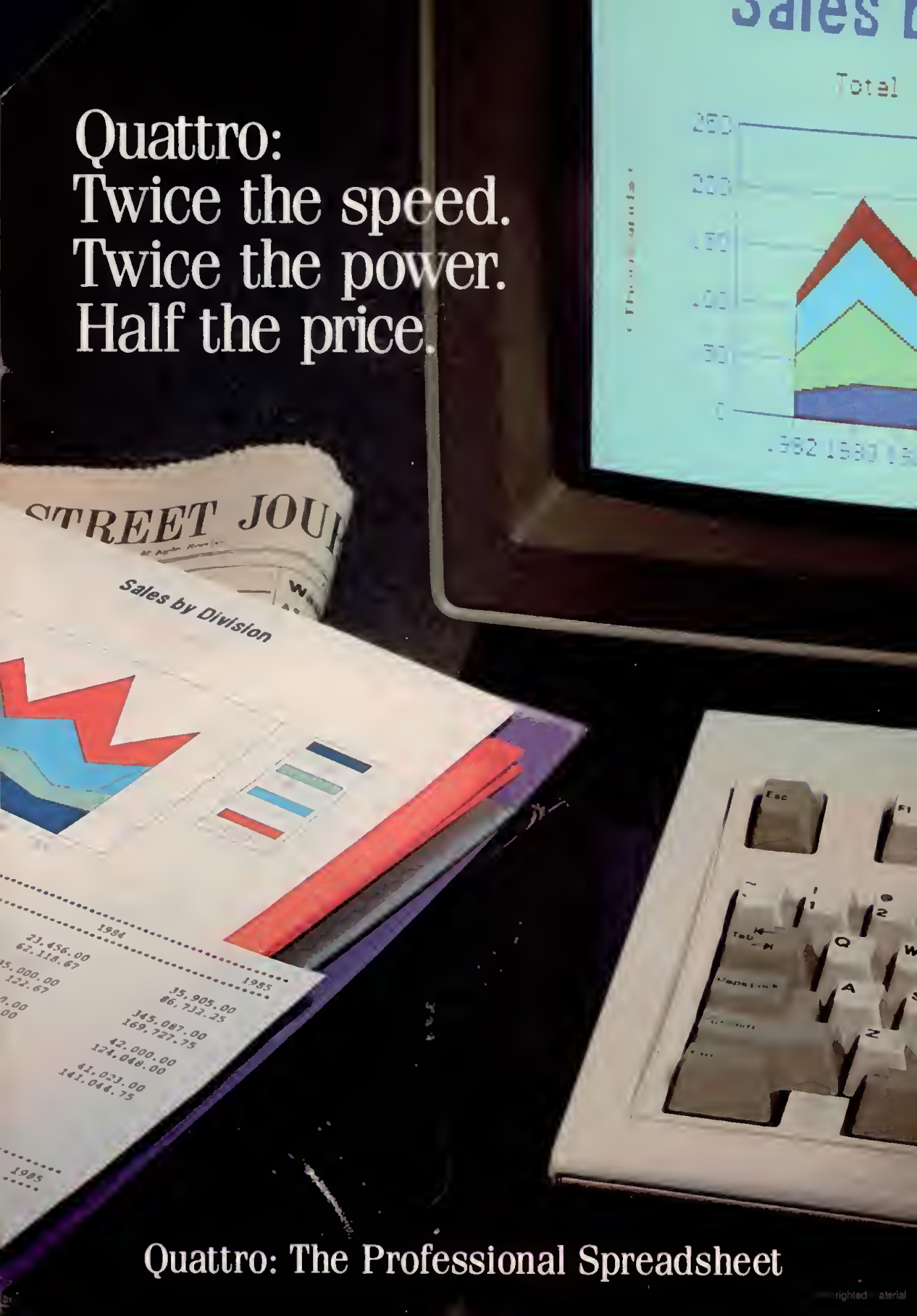
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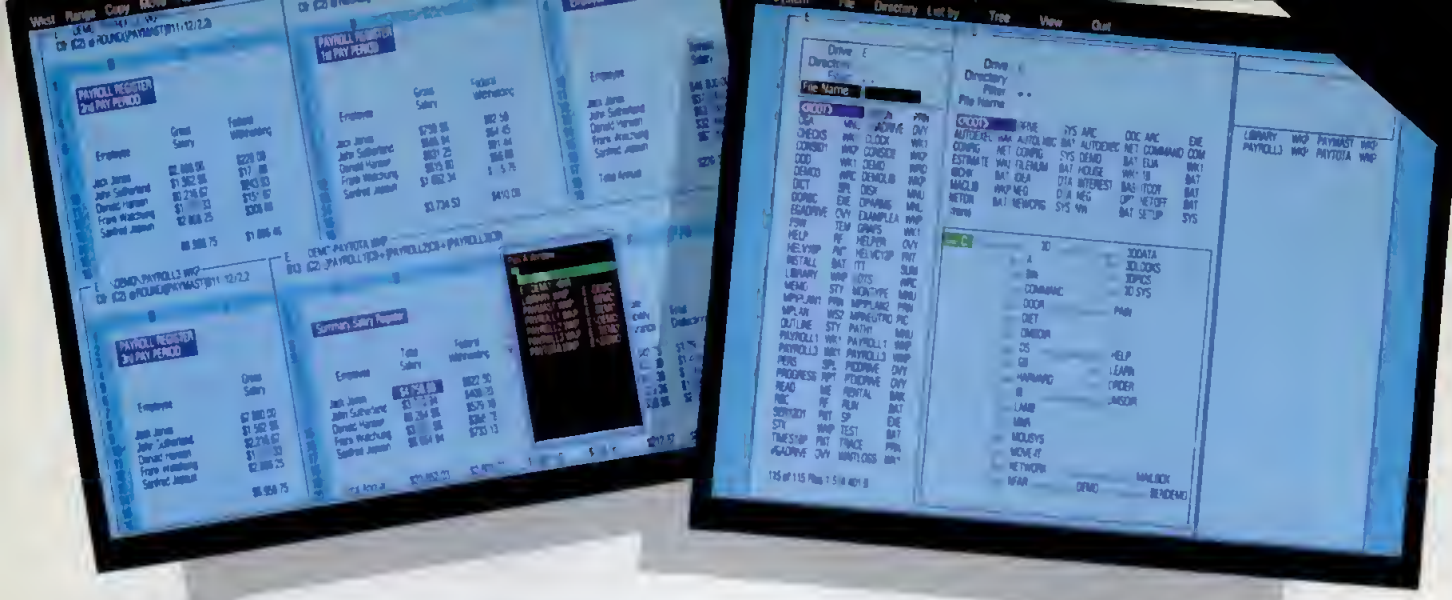

Them All!

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Graphics — Presentation Quality	✓	NO	NO	✓
Graphics — Integrated Printing	✓	NO	✓	✓
Graphics — On-Screen Fonts	✓	NO	✓	✓
Graphics — Full Customization	✓	NO	✓	✓
Graphics — Compare Data from Multiple Worksheets in a Single Graph	✓	NO	NO	✓*
Minimal Recalc	✓	NO	✓	✓
Background Recalc	✓	NO	NO	✓
Single Keystroke Undo	✓	NO	NO	✓
100% 1-2-3 Compatible	✓	✓	✓	NO
Network Support (LAN)	✓	NO	NO	✓
CGA Support	✓	✓	✓	NO
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Visual Manager	✓	NO	NO	NO
Price	$495	$495	$195	$495

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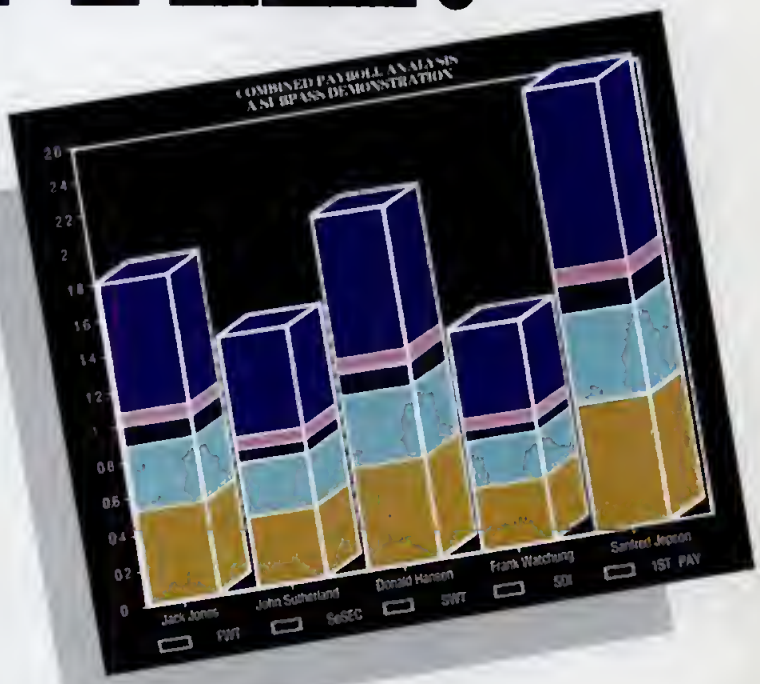

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CIRCLE 167 ON READER SERVICE CARD

WHAT'S INSIDE

Sometimes it's hard not to be blasé. Each week brings us news of faster-cheaper-more-powerful products that promise great leaps forward in flexibility-versatility-reversibility-ease-of-use. We listen to it all, but a great deal turns out to be just so much hype.

Which is why we get excited when something like the Compaq Deskpro 386/20 comes along. The fastest PC we've ever tested, it's a technically elegant machine that incorporates innovations in cache memory, video, and expansion technology. It's a pacesetter that will have a major influence on product development in the rest of the industry.

Bill Machrone and fast friend: Compaq's new 386/20 ups the ante in hardware design and 386 operating environments.

"Hardware guys are always nagging software developers because programs can't keep up with new hardware, and software guys retort that hardware can't keep up with software," says Bill Machrone, who wrote this issue's cover story on the 386/20. "The new Compaq puts the ball firmly back in the software court," he says.

This machine is blindingly, uncompromisingly, dizzyingly fast. Don't even try to watch the memory check on boot-up—we're talking true blink-and-you-miss-it speed here. It'll make you gasp. It made mincemeat of PC Labs benchmark tests. It made Machrone giggle.

Does this kind of speed really matter? You bet.

"The 386/20 makes new multitasking software like *Windows/386* not only possible, but delightful," says Machrone. It's an "optimized environment" for sophisticated programs that should spur developers on to even greater applications.

When he's not writing cover stories, Bill Machrone is giving us invaluable leadership. He's the guiding hand of the magazine, and every issue reflects his philosophy of providing information with depth and scope you just can't find anywhere else.

In his new role as editor-in-chief and publisher of this magazine, Machrone will increase his industry involvement and strengthen relationships with product designers, industry leaders, and technology experts so that we can bring you even better coverage of computing developments. He'll also continue to give us the benefit of his editorial and technical expertise.

And we hope he'll still find time to giggle at fast computers.

A final note. This issue marks the addition of two contributors to the pages of the Productivity section: the brothers Cobb, Douglas and Steven. As the new editors of Spreadsheet Clinic, they take over for Jared Taylor, who continues his work for us as West Coast editor. PC

Photograph: Thom O'Connor

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PC MAGAZINE

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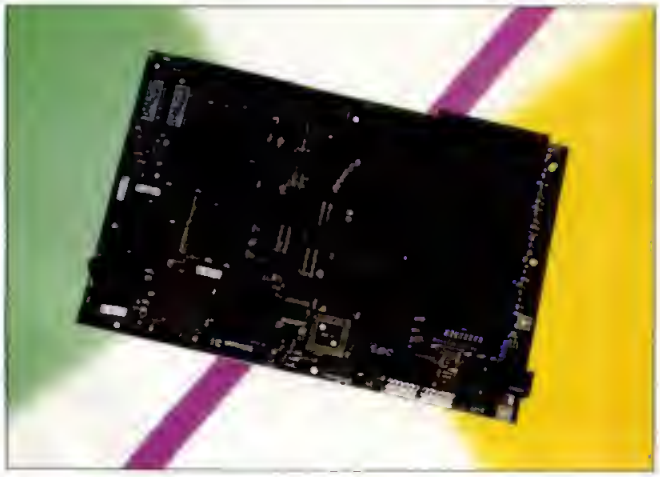

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Roberto Brosan
Cover Screen Image:
Joseph Preiboy

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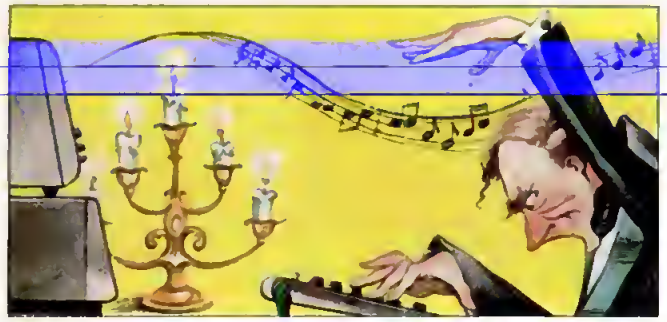

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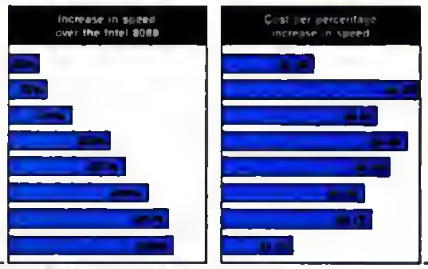

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Steve Manes, PC Magazine
Best of 86 review

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Some nine-wire dot matrix printers hide from the competition. Not the new Citizen™ MSP-50.

With the ability to handle all types of paper, top or bottom feed, and a convertible push or pull tractor, it figured it was the best. However, another printer had designs on the title.

So the MSP-50 relied on its high speed, up to 300 cps, to crush the competition. But it wasn't enough. Feature by feature these two contenders battled. Quiet mode. 240 dpi graphics. Color capability. Choice of fonts. Front panel feature controls. Even compatibility with most major software. They were equal. Finally, the MSP-50 put its 80-column print width on the line. Unfortunately, the other machine offered 136.

What was the other machine? The new Citizen MSP-55. Which just goes to prove that if you want to be considered one of the best, you have to be a Citizen in good standing.

For more information call 1-800-556-1234, Ext. 34. In California call 1-800-441-2345, Ext. 34.

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...kthru 286 performed flawlessly with every appli- ...e handed it, including copy-protected programs and ... memory-resident utilities at one."
Stephen Manes, PC Magazine

"...the Breakthru 286 was the card of choice."
PC BusinesSoftwareview **(Rated #1)**

"...Breakthru 286 is a good value and a quality product backed by effective support."
Dan A. Griffin
The Newsletter of the AutoCAD User's Group

"The PCSG Breakthru 286 achieved the best performance results of the caching boards tested."
Ted Mirecki, PC Tech Journal **(Rated #1)**

"The 12-MHz Breakthru 286-12 speedup board is the fastest of those tested, but not the most expensive. On a dollar per-horsepower basis, it could be called the cheapest boost available for an XT."
Mark Welch, InfoWorld **(Rated #1)**

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Accelerator Cards: Speed and Value

Speed figures are consolidated results from 10 tests of CPU performance (See Accelerator Boards Special Report, December 1, 1986.)

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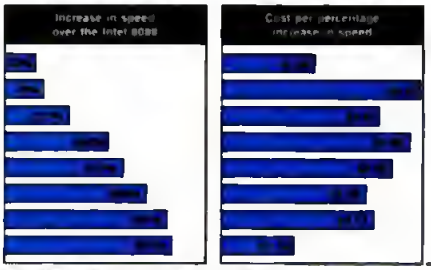
☐ Microsoft Mach 10	$395
☐ Univation Dream Board	$512
☐ Orchid Turbo EGA	$945
☐ ST&D Standard 286	$995
☐ Classic Speedpack	$995
☐ Orchid PC-Turbo 286e	$1,195
☐ **Breakthru 286-12**	$595



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Breakthru 286-8MHz-$395
Breakthru 286-12MHz-$595

LIGHTNING™—FREE with Breakthru speedup hardware—$89.95 purchased separately

We are excited about our three speedup products. You probably know about our Lightning disk access speedup software that was awarded PC Magazine's Best of 1986 award (see box). After the smashing success of Lightning, in late '86, we guaranteed the Breakthru 286 board to be literally the most advanced, fastest, most feature-rich board available. The runaway success it has enjoyed truly proved that assertion. Now we go ourselves one better with the Breakthru 286-12. This new board has the clock speed cranked up from 8 to 12 MHz for speeds up to 10.2 times faster than an IBM PC. It is 50% faster than an 8MHz IBM AT, and up to a whopping 1,000% faster than a regular PC.

But, no speedup board cuts disk access time in half

LIGHTNING

software can - $89.95 or FREE w/Breakthru

"Lightning is almost mandatory...." -
Steve Manes, PC Magazine
Best of 86 review

Loads with the DOS - always ready as a background program to accelerate disk access. You do nothing - everything is automatic. Programs that frequently access the disk (hard or floppy) are made instantly up to 2 to 4 times faster. Uses a principle greatly enhanced from mainframe technology called caching. Fully exploits Above Board memory.

LIGHTNING is the standard against which all our competition measures itself because we achieve universal compatibility with other software. Data is never lost. Order ***LIGHTNING*** separately or get it free with your Breakthru 286 board.

HERE'S WHY THESE TWO BOARDS ARE SO SPECIAL.

First, they install so easily. A half-slot card means you don't even have to give up a full slot. What's more, unlike competing products it works in the Compaq Portable and most clones. Easy diagrams show how you just place the card in an open slot, remove the original processor and connect a single cable. There is no software required. From that moment you are running faster than an AT.

Second, they are advanced. The BREAKTHRU 286 replaces the CPU of the PC or XT with an 80286 microprocessor that is faster than the one found in the AT. Has a 80287 math coprocessor slot for numeric intensive applications. A 16K cache memory provides zero-wait-access to the most recently used code and data. Speed switching software allows you to drop back to a lower speed on the fly for timing sensitive applications.

Third, you have full compatibility. All existing system RAM, hardware, and peripheral cards can be used without software modification. Our boards operate with LAN and mainframe communication products and conform to the Expanded Memory Specification (EMS). Software compatibility is virtually universal.

Faster and smarter than an AT - PCSG guarantees it.

Fourth, these are the best. There are several other boards on the speedup market. We at PCSG have compared them all, but there simply is no comparison. Many cards offer only a marginal speedup in spite of their claims and others are just poorly engineered.

We are really excited about these products. PCSG makes the unabashed statement that the BREAKTHRU 286 card represents more advanced technology than boards by Orchid, Quadram, P.C. Technologies, Phoenix...we could go on. Breakthru 286 is undisputedly the turbo board with the biggest bang for the buck. And we include FREE the $89.95 acclaimed Lightning software. Call today with your credit card or COD instructions and we will ship your card the very next day.

PC MAGAZINE EDITORS' CHOICE BEST 1986

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CIRCLE 489 ON READER SERVICE CARD

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Everyone who tries it, tells us, "It's the best there is."

Don't take our word for it. Use Lucid 3-D for 60 days. Return it for a full refund if not completely satisfied. Plus, instead of the $199 list price, an introductory spread-the-word price of $99.

Lucid 3-D is priced to sell at $199, but we want thousands of people using Lucid everyday, all over the world. We invite you to be a part of that group. The reason we are offering Lucid for only $99, on a sixty day return for a full refund, is simple. Preliminary user testing of the product produces the same results over and over. People tell us they would never work without Lucid 3-D again. Even folks continuing to work with 1-2-3.

Memory Resident

That's because the idea of a memory resident spreadsheet makes sense, one that you can pop-up instantly while working in your word processor or any other program. Lucid lets you cut anything on the screen and paste it right into Lucid, or cut anything from a Lucid worksheet and paste into the application below. You can even run Lucid on top of 1-2-3 if you like, and cut and paste information from one to the other, including formulas.

Lucid 3-D was developed over the past two years with countless, exhaustive hours of planning and programming to produce something spectacular. This is a product that works the way we dreamed a spreadsheet would function. Everyone who has seen it says things like, "*Lucid 3-D is how software of the 1990's will look and perform*", or even more to the point "*This is the way I thought a computer should work*". You'll see, Lucid is exciting.

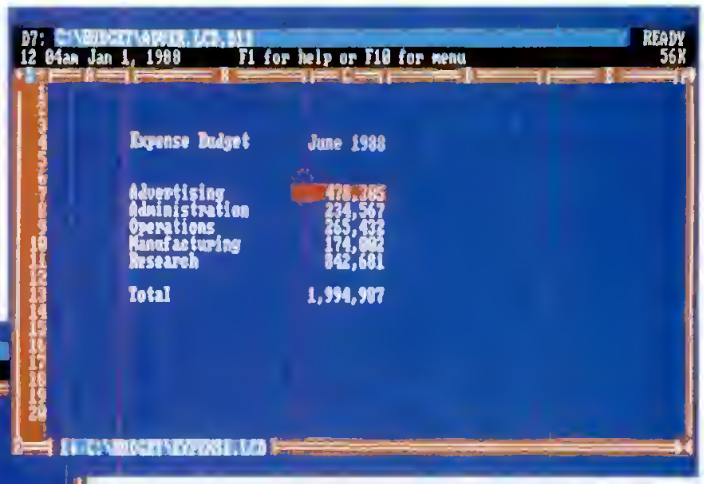


FIG. 2 Here we are, instantly. Notice the lower left corner showing we are on level 2. You can go down or up. (See next page)

FIG. 1 Let's get the detail on those ad costs. Just move the widebar to that cell and press one key (grey +).

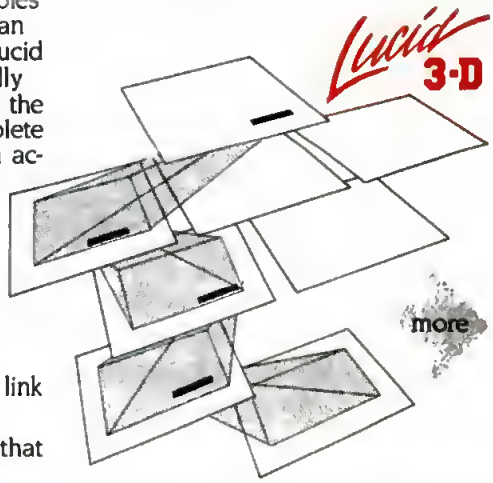
way. Users say "*It is so intuitive that I really don't need a manual.*" That's because we use something we call a visual command menu. Jim Seymour, the noted PC columnist, talking about Lucid in a recent article said that, "*If there ever was an interface idea so good it ought to be stolen and widely used, this is it.*"

What he was talking about is a new menu approach that follows a simple design concept: it is easier to recognize than it is to remember. As choices are made on a menu that take you to lower levels you always can see exactly where you came from and where you are going. The complete menu path is always visible. You cannot get lost several levels down. This means you never have to remember a command, you just flow right to it.

What Makes it so Special

In the screen examples you can see Lucid is really multi-dimensional. Any cell of the spreadsheet can contain a complete other spreadsheet that you can access with a single keystroke. It is as simple as the pictures show. And you don't have to write formulas to do that. All you do is go look at the other file, navigating through easy, point and shoot directories. When you come back up (with one key) the link is made automatically for you.

Everything about Lucid works that



1-800-544-4699

Any cell can contain a complete other spreadsheet that you can access with a single key.

Plus, no matter where you are on a menu or what you are doing, just press function key F1, and you will get a help screen specific to that command or action. Or if you want to know about any subject you can pop up an index of over 400 topics and select the one you want.

Notepad Behind Every Cell

Another 3-D feature is that any cell can also contain a multiple page note that you instantly access with a single keystroke. You can write notes, memos or letters that relate to your work, save them as individual files and even print them separately or with your spreadsheet.

FIG. 3 We want more detail, so let's go to Newspapers. Just press the Grey + Key

FIG. 4. Now, instantly we are on level 3. Each level is a different spreadsheet. You could now move to the New York Times and see the detail on that figure. There is no limit to the levels you can go. Move right down to transaction level if you like.

> "The best idea I've seen for a spreadsheet in years."
>
> Jim Seymour, Columnist, PC Magazine, PC Week

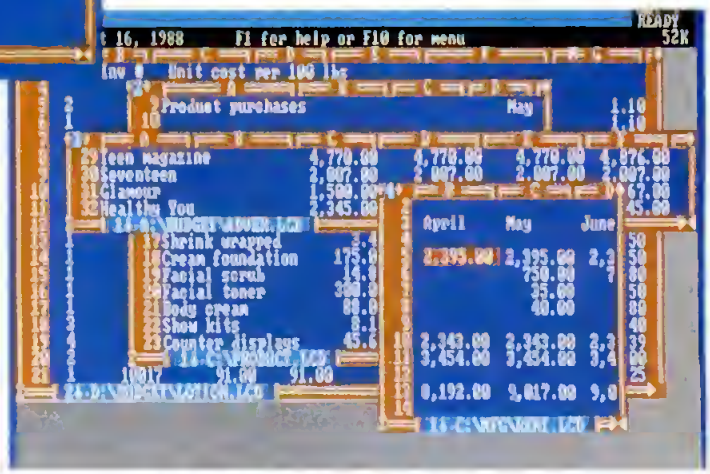


Fig. 5. Of course, Lucid does multiple windows. Notice, you can simultaneously open windows in different directories, different drives, even down as many as 3-D levels as you like. No one else can do that.

Speed

Lucid 3-D is truly revolutionary. It is fast, fast, fast! It is incredibly quick in performing calculations because it doesn't recalculate every cell every time you insert an entry. Instead, it only recalculates the specific cells that are affected by your change. This is called minimal recalc. Lucid also has a remarkable innovation called background recalc in which you are given control of the cursor the moment calculations affecting your viewing screen are completed. Other calculations you don't see continue on in the background during the next commands. The end result of this powerful combination is you rarely wait for a recalculation with Lucid. You find out what instantaneous is all about.

Lucid Learns

Lucid 3-D also lets you teach it any combinations of keystrokes so that involved sequences can be done with single keys. Plus more than just remembering keystrokes, Lucid allows you to create Macros with loops, procedures and conditional branching amazingly all done automatically with simple menus. You can create your own menus that show the new features you have taught it. Another great feature is you can make your custom menus work like Lucid where one choice can take you down a level to a whole new set of choices. What's nice is that they will work from one spreadsheet to another.

Mouseability

Lucid 3-D was designed for both keyboard enthusiasts and mouse lovers alike. You can take your pick. Designed around the mouse from the ground up, the interface is smooth and natural. You select files to load from directory lists. Everything is point and click. What's more, any Lucid 3-D menu selection can be "moused" and the response time is "right now" instead of the sluggish "a little bit behind you" feel of add-on mouse menu systems like those you've seen with 1-2-3.

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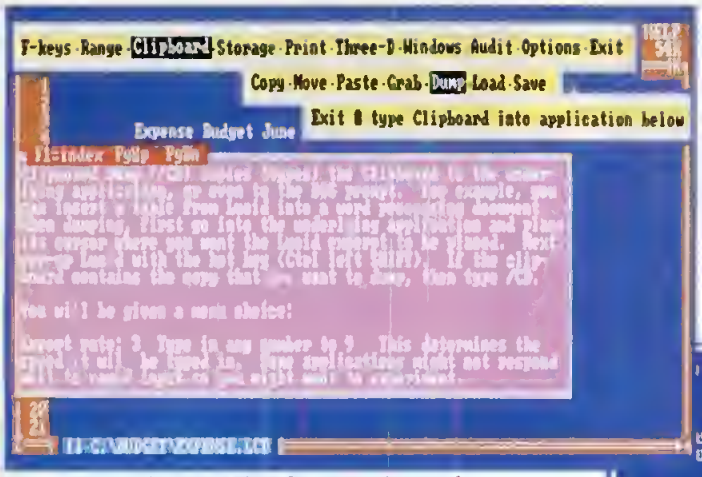

FIG. 6 We need those budget figures in the Word Perfect letter we are writing. Clipboard Dump does it right now.

FIG. 7 Here it is right in Word Perfect (or any word processor) just like you typed it. You can go the other way just as easily.

A window pops up with a library of function names you can page through with the mouse. Select, click and it's in the formula with no typing required. You even have a label window that you can fill (from the keyboard) with favorite labels and names so that you can insert them later with the mouse. There's even a pop-up calculator to insert numbers so you don't have to go to the keyboard very often.

It really permits that feeling of becoming one with your work. Lucid 3-D has windows of user defined range names as well as the macros named by the user that can be selected just by pointing and clicking. Icons that are easy to grab with the mouse let you resize and move the spreadsheet window with the ease you would expect. Plus you can go anywhere on the sheet by moving the mouse and clicking on the spreadsheet borders. And remember Lucid is designed so that any of those features are done with or without the mouse easily and quickly.

Audit

When you are staking a big decision on information gained from a spreadsheet you need to be certain that you have made no mistakes. Lucid offers five audit displays and printouts.

Masterwork

We could go on at great length about all the features and innovations in Lucid, but Lucid is more than a bag of features. What is most important is the pride and craftsmanship that went into its creation. It is a masterwork. The overall feel is tight and polished. In fact, Paul Somerson, executive editor of PC *Magazine*, used one word to describe it, "*Slick*".

PCSG has built a reputation as a development laboratory producing products that you know are excellent. In 1983 PCSG dominated the Model 100 laptop market with ROM based software that every reviewer rated as excellent. In 1985 we produced ***LIGHTNING*** the pioneer and award winning Disk speed up software. In 1986 we developed the ***BREAKthru 286*** accelerator board that blew everything else out of the water, and later we topped ourselves with the Breakthru 12. Now in 1987 those who have worked with Lucid 3-D tell us "*you have done it again. This is software everyone should have.*"

Even if you don't plan to abandon 1-2-3, Lucid makes sense. Files are converted between them with ease so there's not an interoffice compatibility problem. This means you can have the power and fun of Lucid 3-D without having to upset your present systems.

We are excited about Lucid 3-D. But don't take our word for it, take us up on our 60 day offer. Call us on our order line number and we will ship your order the very next day. This $99 offer won't last because we will be shipping to the dealers soon. But in the mean time we invite you to try Lucid as part of our "spread the news" campaign. Just pick up the phone and call us. We accept all major credit cards or you can order COD.

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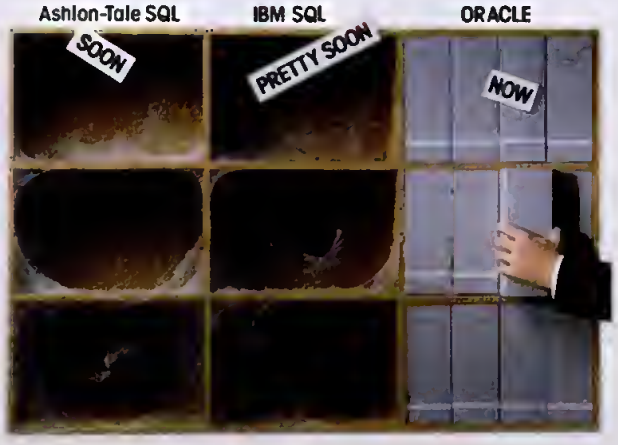

If you're looking forward to OS/2 and the next generation of PC database management systems to enable you to build larger, higher-quality PC applications, you'll be interested to know that:

- Ashton-Tate has announced its intention to replace its outdated database technology with a SQL DBMS under OS/2, and
- IBM has announced its intention to offer SQL for OS/2 in its Extended Edition.

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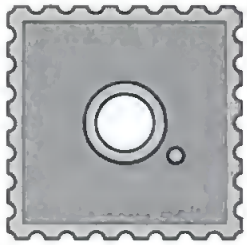
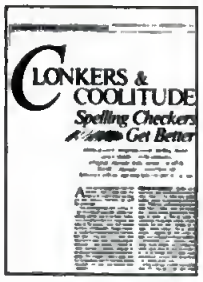
LETTERS TO PC MAGAZINE



RIGHT ISN'T WRONG

I have never written to a magazine before, but I could not resist after reading Mr. Mendelson's opening sentence in "Clonkers and Coolitude: Spelling Checkers Get Better" (*PC Magazine*, October 13, 1987): "A wise old newspaperman once told me that I had to learn only two rules to be a good writer: use long and short sentences alternately and spell the words right." Unfortunately, the old newspaperman forgot to mention a third rule: use the words correctly—"right" is an adjective. This gaffe is destined to be a classic.



Prof. Mark Brighton
Irvine, California

I am always baffled by people who obey rules that have no relation to reality. The Oxford English Dictionary *lists more than 300 examples of* right *used as an adverb in books ranging from* Beowulf *to the Authorized Version of the Bible and by such authors as Shakespeare, Milton, and Thoreau, plus an English prime minister and a president of Harvard. Whom are you going to believe, somebody's grammar book or a thousand years of history?*
—Edward Mendelson

THE MULTIMATE ADVANTAGE

Being a *MultiMate* user, I must come to its defense. Marvin Bryan's article "A New Page for MultiMate?" (*PC Magazine*, October 27, 1987) is a bit heartless in that it assumes page orientation is death in a word processor. What is the magical fascination with *Microsoft Word*'s document orientation? Using *Word* is like writing on toilet paper—it keeps scrolling and spewing. Sure, you can mark pages and enter a quasi-page mode, but it is inconvenient. *Word* does some very nice things and has a few tools *MultiMate* could use, but *MultiMate* has been a powerful, straightforward, and convenient friend for 3 years. And I only have Version 3.3!

Wink Grise
Osterville, Massachusetts

It is obvious by his unfair review that Marvin Bryan is a biased, non-*MultiMate* user ("A New Page for MultiMate?"). I have been a *MultiMate* user for 3 years and find it extremely easy to learn and use. I have also used *WordPerfect* and found it awkward to use, unintuitive, and very difficult to learn. There are, admittedly, some useful features missing from *MultiMate Advantage II*; however, I don't feel that *WordPerfect* offers a significant enough advantage over *MultiMate* to entice me to change.

Dan Arnett
Burlingame, California

BEYOND 1-2-3

While perusing the latest computer rags in the local software store, I noticed the bold heading "Power Beyond 1-2-3" on the cover of your October 27 issue. I could not help but pinch myself. Could this be true? Was someone finally helping me and saying there are spreadsheets better than *Lotus 1-2-3*?

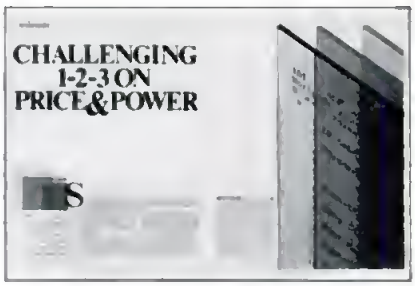
Lo and behold, it was true—you guys scooped everyone ("Challenging 1-2-3 on Price and Power," *PC Magazine*, October 27, 1987). *Lotus 1-2-3* is not the best spreadsheet in town. Thank you very much for giving me some solid answers to my spreadsheet questions.

David A. Cornelson
New Berlin, Wisconsin

Many thanks and compliments on your spreadsheet issue ("Challenging 1-2-3 on Price and Power"). As usual, it was well researched and extremely useful. Your writers are to be congratulated.

Jerome A. Schroeder
Seattle, Washington

In your cover story "Challenging 1-2-3 on Price and Power," you omitted the spreadsheet that has been rated the highest in



power and performance for 2 consecutive years by The Software Digest Ratings Report: *The Smart Spreadsheet with Graphics* from Innovative Software.

Not only is *The Smart Spreadsheet* faster than *1-2-3*, but it imports/exports Lotus files. When you combine that with the fact that *Smart* is also available in UNIX and Xenix and provides data compatibility between the DOS and the multiuser environments, it means *Smart* users can enjoy today what OS/2 is only promising for tomorrow.

Paul S. Bruski
Innovative Software
Lenexa, Kansas

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NEW RELEASES UPDATES

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- ☐ **EDUCATION 3**—PC-Fastype 1.20 typing tutor, ideal for beginners and advanced students alike.
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- ☐ **GRAPHICS 1**—Record and play back screen images! Excellent for demo, etc. Color required.
- [3] **GRAPHICS 2a,b,c**—(3 disks) An excellent 3-D surface modelling and shading program. Color.
- [2] **INFO 2a,b**—(2 disks) Zip-Phone, national areacode/prefix to zip-code cross reference.
- [2] **LANGUAGE 3a,b**—(2 disks) The A86 3.09 macro assembler and debugger for 8088/86/286s.
- [2] **SHELL 4a,b**—(2 disks) Automenu and HDM II 4.04 hard disk prog. for custom full-screen menus.
- ☐ **UTILITIES 5**—Hard disk utilities for verifying, formatting, parking and optimizing your disk drives.
- ☐ **UTILITIES 6**—Advanced utilities including Mark/Release (remove resident progs w/o reboot!).
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■ LETTERS

What has no multidimensional database, no direct access to *dBASE* data files, recalculates slower, uses more disk space for the template and more RAM for the program, has fewer rows, and costs three times as much as *VP-Planner*? Answer: Daybreak Technologies' *Silk*, your Editor's Choice for spreadsheets ("Challenging 1-2-3 on Price and Power").

Although I usually respect your Editor's Choice, you really blew it this time. Perhaps flash counts for more than utility and a reasonable price, but not with me. I'll stick to *VP-Planner*.

R. E. Thalmann
Fairbanks, Alaska

DEMAND FOR ETHICS

Jared Taylor's glib comment, "Accountants have always been able to cook the books after the fact" is irresponsible, uncalled for, and a disservice to the entire accounting profession ("Analyzing Data from All the Angles," *PC Magazine*, October 27, 1987). Both public and private accounting professionals must adhere to codes of ethics and public law, which demand integrity. I think *PC Magazine* should demand more from its contributors.

Robert Harris
Stamford, Connecticut

UTILITIES CHEERS

Three cheers for Jeff Prosise's fantastic utility CARDFILE.COM (Utilities, *PC Magazine*, October 13, 1987). It is one of the most handy TSR utilities I have, and I really enjoy using it.

David Kerbow
Austin, Texas

Although I enjoy the utilities published in *PC Magazine*, it has struck me that most of your TSR programs cannot be unloaded from memory. For instance, CARDFILE.COM (Utilities, *PC Magazine*, October 13, 1987) takes up about 70K bytes of RAM. It would be nice if I could easily unload the program whenever I needed that extra RAM to run other TSR programs.

I would like to suggest that you encourage all the authors of your TSR utilities to include an Unload feature in these programs.

A. Dafni
Las Cruces, New Mexico

We strive to make all the utilities presented in the Productivity section of the magazine useful, full-featured, small, and tutorial in nature. By showing a variety of techniques, we hope to give you the tools to construct your own assembly language utilities. But to have each program include every feature would make them too large to publish. We suggest that you take advantage of our INSTALL/REMOVE utilities (PC Lab Notes, PC Magazine, August 1987) to remove CARDFILE when no longer needed.

■ As a new programmer, I can't believe how much of the information in the Productivity section is useful to me.

For years, I had always programmed in interpreted BASIC. Just recently I purchased one of the new BASIC compilers, and I am learning to write assembly language subroutines for those BASIC programs. Because of all my new programming fun, I have been paying more attention to the Productivity section of *PC Magazine*. It seems to me that you have dedicated more space to this section and added more columns. Well, I would just like to say thanks. As a new programmer, I can't believe how much of the information is immediately useful to me. I imagine I will learn much from the Productivity section in the future.

Paul J. Polillo
Lubbock, Texas

Your magazine is truly amazing. Just when I think I have run into an insolvable

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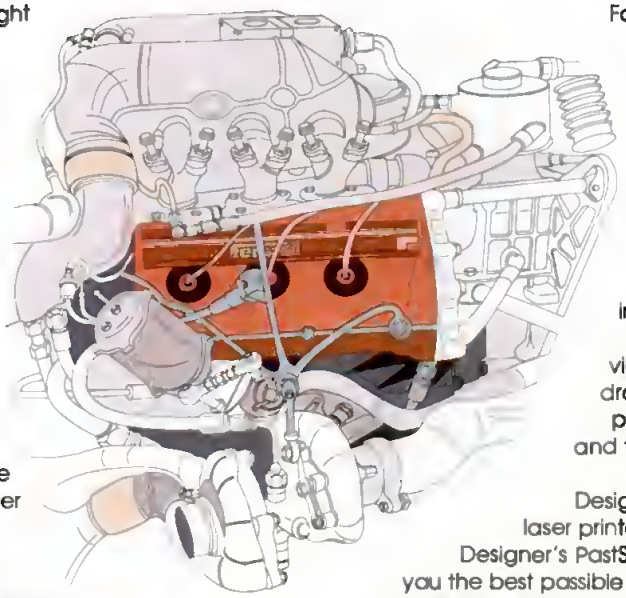

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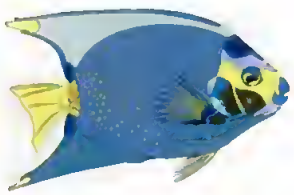

Trace a scanned sketch or photograph.

Reshape complex curves and parabolas.

All illustrations were created with Micrografx Designer.

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■ LETTERS

problem, I receive an issue with just the answer I need.

Most recently, I bought financial software that allows me to get current stock quotes on-line. Unfortunately, I found the only way to save the displayed quotes was to use Shift-PrtSc. Sure enough, when I tried it, I got a cryptic error message and my computer locked up. The only option was to copy the quotes by hand, which kind of defeated the purpose of using a computer. Three days later I received your SNIPPER.COM utility (Utilities, *PC Magazine*, October 27, 1987). Needless to say, SNIPPER solved my problem more efficiently than I could have hoped for.

Jeffrey B. Ellis
Grandview, Missouri

■ Ethan Winer's articles on screen writing in BASIC will go a long way toward improving the art of programming on PCs.

In your October 13, 1987, issue, I came across the BASIC program to create CARDFILE.COM (Utilities, *PC Magazine*). Although I had never attempted to type one of these programs into my computer, this looked like one I wanted. After many hours of typing and replacing commas with periods and making 37s out of 39s, I ran the program and became a proud owner of CARDFILE. This program has been a fantastic utility for me, in that it is big enough for the type of information I need and it works! I highly recommend it.

Craig Stuehling
Phoenix, Arizona

THE SHELL GAME

In the Letters column of *PC Magazine* (October 27, 1987), John C. Dvorak commented, "If DOS shells are so great, where are all the millionaires who designed this software?" Does Mr. Dvorak think that the merit of a work is indicated only if its creator has made piles of money? That's like saying jazz musicians are not as good as pop musicians because they typically make far less money. His point really displays the ugly American sentiment that money is the only (or at least the best) measure of merit.

I don't use DOS shells myself, but I see by the letters in that issue that many readers find them useful. Is there better proof that they are a good idea?

Tom Reingold
Edison, New Jersey

BASIC BRAVO

I would like to commend you on a fine magazine. I especially enjoy your PC Lab Notes and Utilities columns. Articles such as Ethan Winer's "Fast Screen Writing in BASIC, Parts 1 and 2" (PC Lab Notes, *PC Magazine*, October 13 and 27, 1987) will go a long way toward improving the art of programming on PCs.

Chris A. Kantack
Statesville, North Carolina

Congratulations to Ethan Winer for his two outstanding articles on BASIC screens (PC Lab Notes). This is exactly what programmers need, especially in the new QuickBASIC/Turbo Basic environment. Let's have more of these articles!

A. Stark
Arlington, Virginia

CORRECTIONS/AMPLIFICATIONS

The correct phone number for Advanced Gravis Computer Technologies is (800) 663-8558 (After Hours, *PC Magazine*, September 29, 1987).

HOW TO WRITE TO PC MAGAZINE

Do you have a comment, compliment, or criticism about something you've read in *PC Magazine*? A question you'd like to open up to other readers? Then send your opinion to Letters to PC Magazine, One Park Avenue, New York, NY 10016, or through MCI Mail to PCMAGAZINE.

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"WOW! It was more than I expected.

"I read through the past newsletters on disks for 1985, 1986 and 1987 in two sittings. It was enjoyable. I learned a great deal and it whetted my appetite to try more.

"I am also impressed with the shareware concept. I get a chance to try the programs with minimal investment and lif the program doesn't suit my system, needs, or tastel, there is no big loss as there would be with a commercial program.

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What Does The Clipper Compiler Do?
Clipper™ compiles dBase III™ and dBase III Plus™ source code programs, procedure and format files into a binary program which can be distributed and executed independent of dBASE.

How Much Faster Is Clipper?
Applications run anywhere from 2 to 20 times faster than the same application in dBase III or dBase III Plus. The average application typically runs 5 or 10 times faster.

How Compatible Is Clipper With dBase III and dBase III Plus?
Clipper supports the majority of dBase III commands except those that are normally used interactively. There are some minor differences in the implementation of some other commands.

DBF, FRM, MEM and LBL files are the same as interpretive dBase III. Clipper index files have the extension .NTX (corresponding to dBase .NDX) and result in faster indexing and more efficient use of disk space.

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Does Clipper Support Networking?
Yes. Both versions Autumn '86 and Summer '87 allow you to run compiled applications on most major networks. They feature record and file locking and support Expanded Memory.

A second work station may view or read a locked record or file and produce reports. However, an operator of the second station cannot update or write to a locked record or file.

Do I Need Any Kind of Runtime Module To Run A Clipper Compiled Program?
No. Clipper produces an object code module with the extension OBJ. When the .OBJ file is linked (using PLINK86 which is included) a relocatable file with the extension .EXE is produced which can be run directly from DOS.

Do I Need Clipper For Every Program I Distribute?
No. You can compile and distribute as many programs as many times as you wish. Nantucket charges no runtime or royalty fees for distribution of your compiled applications.

Are There Royalties For Adding Work Stations?
No. Clipper places no limits on workstations. You may add as many work stations as your networking software will allow with no additional fees.

Does Clipper Handle Memo Fields?
Yes. Memo fields can be stored as string values, allowing them to be searched, concatenated and REPLACEd. ASCII text files can be read into memofields and memofields can be read into ASCII text files.

What Size Are Clipper Compiled .EXE Files?
The minimum size Clipper file is about 120K. This overhead is a one time expense and is present in even the smallest program. DOS requires 30-40K of memory. In addition, Clipper requires 64K for its own purposes once loaded, which means that in a 256K machine you could load a program of about 160K into RAM. If you create a program that exceeds your computer's memory, you may create overlays to work around the problem.

What Are Overlays?
Overlays are portions of your application that will NOT reside in your computer's memory until executed. An area of memory is designated for overlays by the linker. You then specify which portions of your program are transferred in and out of that memory area.

In What Language Is Clipper Written?
Clipper is written in the C language with some assembly language routines.

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Does Clipper Allow You To Create Windows?
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Will Clipper Interface With Microsoft Windows™?
Clipper will run and compile with Microsoft Windows™ but will not run as a separate task.

Is Clipper Limited To 640K Of RAM?
No. Clipper employs the Lotus/Intel/Microsoft™ expanded memory protocol, allowing use of up to 1 megabyte of RAM.

What Hardware Is Required To Run Clipper?
Clipper runs on any IBM PC, XT, AT, 3270 or 100% compatible machine running DOS 2.0 or greater for single user applications. Networking applications run on most major networks supporting DOS 3.1 or higher.

Is Clipper Copy Protected?
No. Copy protection was removed with the release of the Autumn '86 version.

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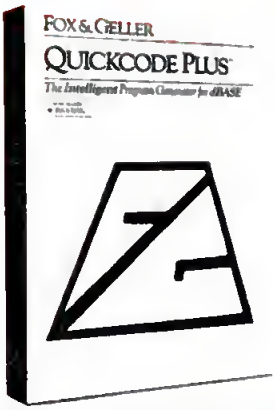

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Generic LOOKUP and UPDATE functions are provided on the disk as dBASE source code, which you can add to your own dBASE library. All generated code is highly optimized, modular, commented, 100% compatible with Clipper and FoxBase+, and conforms to the programming standards recommended by experts like Tom Rettig and Adam Green. User manual includes extensive documentation of the generated code and instructions on how to permanently embed your own changes in the generated code. Truly the King of code generators.

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BRIEF/dBRIEF

The Power Environment for dBASE Programming

Many worthy utility products supply needs that dBASE's programming language doesn't—dUTILITM, dFLOWTM and a host of others. Trouble is, you have

to use them separately, then combine their output into your dBASE program files.

No longer. dBRIEFTM, written in BRIEF's macro language, grabs hold of BRIEF and turns it into a complete dBASE III and III Plus programming domain. Using BRIEF's underlying shell capabilities and its own interfaces, dBRIEF can run external utility libraries, plus dBASE itself, and link to the ClipperTM, Foxbase+TM and Quicksilver compilers, all with dBRIEF still loaded and running the show. It can do what BRIEF already does, plus:

- Convert a screen layout into dBASE code for interactive data entry.
- Display dBASE file structures in windows, a great convenience alongside your program files.
- Expand keystrokes into full dBASE statements.
- Indent automatically for elegic display.
- Create databases, index files, invoke Ashton-Tate's dFORMATTM and dCONVERTTM, draw lines and boxes.

"Simply marvelous programming environment for writing and editing dBASE programs.", *PC Magazine*, 7/86. Source code included!

Requires BRIEF 1.32 or later and 384k. 512k to run dBASE within dBRIEF. 640k and harddisk recommended.

BRIEF/dBRIEF. List **$275**. Ours **call**.

dBC *Identical dBASE III Plus Files Using C*

dBCTM is a series of C libraries from Lattice which creates, accesses and updates files identical to those of dBASE itself. So dBASE can read and update the files too.

What for? It means both C and dBASE applications can operate on the same data bases interchangably. It means C programmers can interface with the big market of dBASE users out there, yet side-step the dBASE language. It means dBASE applications can now be linked to the universe of C libraries and tools to add windows, graphics, statistical analysis, all the things dBASE cannot do. It means the speed and power of C to impress clients accustomed to dBASE!

dBC's functions parallel all dBASE's file handling commands, many decomposed to permit direct data manipulation. Ten each of data, index, and memo files may be open at once. It's so complete an ISAM package that you can forget dBASE and use dBC only for C programming.

Our versions of dBC mimic file formats for dBASE II and III and now dBASE III Plus makes your programs network ready! as many stations as a network allows. Hands-off mode handles record and file locking and unlocking automatically. Close in functions give you direct lock/unlock control.

Supports all four memory models. Specify compiler and dBASE version. For dBASE II, III. List **$250**. Ours **$195**. For dBASE III Plus. List **$750**. Ours **$595**.

Pay double and you get source too!

WALLSOFT'S THE UI PROGRAMMER

Code generator for dBASE

The UI Programmer was developed for professional dBASE programmers who have been frustrated in the past by code generators. Up until now, a serious dBASE programmer had to take whatever code a generator produced and modify it to their needs. With UI, the developer can generate exactly the dBASE code wanted.

UI (User Interface) has two main functions: the first is a powerful forms editor to create sophisticated screen and menu forms in a matter of minutes. The editor is completely menu-driven. It works on the "point-and-shoot" principle—just put the cursor where you want and tell UI what to put there.

UI's other, more important, main function is generating code for the forms you've designed. Once you have a form the way you want it, you call up the "Generate" menu, and tell UI which template you want to generate the code with. That's the key—each template tells UI to produce a different kind of dBASE program.

It's through these templates that you can *program* the way UI generates source code. You can use the templates that come with UI "as is" (there are about 25 of them), completely rewrite them, or write your own. So you don't lose control of *design*, like you do with other generators. You just let UI do the tedious work.

	List	PC Brand
UI	**$295**	**$244**
DOCUMENTOR	**$295**	**$244**
dFLOW	**$149**	**$124**
DATA-p	**$ 60**	**$ 50**

dBASE AT THE SPEED OF C

dBx Translates dBASE Applications to C

You dBASETM programmers know what an expressive and readable language dBASE is. It's a very comfortable development environment. But the price is debased performance. Even compiled dBASE doesn't offer the speed that some users require these days. The kind of speed offered by software written in the C language. The answer is dBxTM.

dBx translates dBASE to C. It offers you a major competitive advantage over the next dBASE programmer. Keep writing in dBASE. Take every application all the way to completion. Then use dBx to translate them top to bottom to C!

Other advantages: C is portable, even to other operating systems like UNIX/XenixTM. To the Macintosh or Amiga. dBx gives your applications a passport to places dBASE cannot go.

Has its own file manager for single user, but links to major C file managers—c-tree and dBC—for compatibility with dBASE files or multi-user support. We have everything you'll need, including good advice.

	List	PC Brand
dBx	**$ 350**	**$ 299**
with Library Source	**$ 550**	**$ 469**
with Full Source Code	**$1500**	**$1282**

OVERDRIVE *Take the Doze out of DOS*

If you are one of the millions of personal computer users who are frustrated by slow disk access, you need OVERDRIVE. Overdrive will make your disk-limited programs such as databases run faster. How fast? It depends upon your particular circumstances, but 50% speed increases are not uncommon.

For example, a dBase III accounting program ran 50% faster and a large Condor 3 database whose SORT time was 80 minutes, ran the same sort under Overdrive in 13.

Overdrive is not a disk cashe, an optimizer or a RAM disk. In fact, Overdrive will run even faster on your RAM disk because Overdrive eliminates the DOS "thinking time", not the disk time. Overdrive hooks itself into DOS and replaces its old slow program code with modern, efficient, well-designed routines.

Overdrive adds handy directory utilities and improves the speed of DOS backup and copy functions remarkably. Runs transparently and takes up only 2KB of RAM for itself plus around 1/2KB per Megabyte of hard disk capacity.

PC Brand **$69.95**

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SUPER SOURCE

Aldebaran's Source Print

Author Alan Simpson writes "the best overall debugging technique is to draw lines to connect all the IF and DO WHILEs etc with their ENDIFs and END DOs Then use a pencil to"—Well thanks, Alan but we'll use Source Print instead It draws those vertical lines to connect the beginnings and endings of structure in a vivid display of your program's organization It can print your programs with page numbers headings, line numbers, indent automatically, throw in a table of contents and cross-reference index "Occasionally a utility comes along that makes a programmer s life much easier Source Print is such a program" says *PC Magazine* List **$97, Ours: $75.**

...add Tree Diagrammer

Tree Diagrammer prints an organization chart of your program's structure showing the hierarchy of function, procedure, and subroutine calls Shows at a glance what routines call each other for clearer debugging Every shop should have this important documentation tool List **$77** Ours **$67.**

C-TREE & R-TREE

B-Tree File Manager Now Has Report Generator

c-tree: The only major b-tree file manager with network support in the standard low-cost version. c-tree™ gives you record-locking routines for DOS 3 1/3 2, UNIX and XENIX, and it even comes in C source code yet there are no royalties Source sticks to K&R, so C-tree is portable Tests in many environments prove it

Permits any number of keys for a data file—alpha, numeric even floating point Handles files with varied record lengths, multiple keys in one index file Both high level and decomposed functions It s the works

r-tree: Adds the ability to produce ad hoc reports from files maintained by c-tree (v 4 1 and up) Link a file description to the r-tree™ library, and use any text editor to write report scripts with no further C coding Reports can access data in several files select on criteria, join findings into new logical records sort them, calculate new fields and columns, tabulate by control breaks Comes in source, same portability as c-tree, and fits any compiler

	List	Ours	Combined
c-tree	**$395**	**$329**	**$541**
r-tree	**$295**	**$245**	

WINDOWS for DATA

FIRST PRIZE!

M'Soft Windows Compatible

Only one package can be easily recommended" said *Computer Language* (June '87) reviewing nine window and data entry products for C Complete field level functions specify prompt string, field length data type screen location picture target variable entry rules help messages even functions to call for validation once data keyed in

Windows for C is a subset No data entry but all windowing functions Unlimited windows can be made either to pop up or permanently overwrite the screen scroll and highlight lists vertically and horizontally Specify Compiler Windows for Data List **$295,** Ours **$259.** Windows for C List **$195,** Here **$149.**

ESSENTIAL C UTILITY LIBRARY

400 Functions, 30c Each

You've probably seen the speed and power of Essential s C function library without knowing it Software greats have been using it for some time to give today s top products pizazz and panache

Now grown to 400 functions Essential produces pop-up menus, saves and restores screens and windows to disk or memory in as little as 1/10th second and claims the fastest video output available Library has 50 business graphics functions, 40 string handlers 28 functions for printers, 18 for mice, 11 for time and date, DOS interface functions for disk error trapping, directory and file creation and management, lots more Everything in source, including sample programs We have versions with pre-built libraries for the well-known C compilers, and a source code librarian is supplied for rolling your own

	List	PC Brand
C Utility Library	**$185**	**$119**
Essential Graphics	**$250**	**$183**
Essential Communications with Breakout Debugger	**$185** **$250**	**$125** **$189**

Shopping List for the Power Workbench

	LIST	US
ARITY PRODUCTS		
Arity Combination Package	1095	979
Expert System Development Pkg	295	229
PROLOG Advanced Toolbox	150	119
PROLOG Compiler & Interpreter	650	569
Arity File or Screen Design Toolkits	50	44
SQL Development Package	295	229
Arity PROLOG Interpreter	295	229
Arity Standard Prolog	95	77
AI-EXPERT SYSTEMS		
EXSYS *Development Software by EXSYS*	395	309
EXSYS Runtime System	600	469
Insight 2+ *by Level Five Research*	485	379
AI-LISP LANGUAGE		
IQCLISP *by Integral Quality*	300	Call
IQLISP *by Integral Quality*	270	Call
Microsoft LISP *Common LISP*	250	199
TransLISP *from Solution Systems*	95	Call
TransLISP PLUS *from Solution Systems*	195	Call
AI-PROLOG LANGUAGE		
APT *Active Prolog Tutor from Solution Sys*	65	Call
Prolog-86 *from Solution Systems*	125	Call
Prolog-86 Plus *from Solution Systems*	250	Call
Turbo PROLOG *by Borland Int'l*	100	63
Turbo PROLOG Toolbox *by Borland Int'l*	100	64
ASSEMBLERS & DEBUGGERS		
Advanced Trace-86 *Morgan Debugger*	175	119
C-Sprite Debugger *by Lattice, source level*	175	139
Microsoft Macro Assembler *with Utilities*	150	109
PASM86 *by Phoenix, Macro Assembler*	195	139
Periscope I Debugger *The Periscope Co*	345	289
Periscope II *with NMI Breakout Switch*	175	139
Periscope II-X *software only*	145	105
Periscope III *with Advanced Board New*	Call	Call
BASIC LANGUAGE		
Microsoft BASIC Interpreter *for XENIX*	350	295
Microsoft QuickBASIC Compiler *3.0*	99	79
BORLAND PRODUCTS		
Reflex & Reflex Workshop	200	129
Reflex *Data Base System*	150	89
Reflex Workshop	70	45
Turbo Basic *New*	100	64
Turbo C Compiler *New*	100	64
Turbo Lightning	100	64
Turbo Pascal & Tutor *New*	125	85
Turbo Pascal with 8087 & BCD	100	64
Turbo PROLOG Compiler	100	63
Turbo PROLOG Toolbox	100	64
Turbo Tutor	40	26
C COMPILERS		
C86 PLUS *by Computer Innovations New*	497	397
Lattice C Compiler *from Lattice*	500	299
Let's C Compiler *by Mark Williams with CSD Source Level Debugger*	75 125	55 90
MWC-86: Mark Williams C Development	495	369
Microsoft C Compiler *4 0*	450	285
Turbo C Compiler *by Borland New*	100	64
C INTERPRETERS		
C-Terp *by Gimpel Software*	300	249
Instant C *by Rational Systems*	500	395
Interactive-C *by IMPACC with debugging*	249	219
RUN/C Professional *from Lifeboat*	250	185
COMMUNICATIONS		
Asynch Manager *by Blaise, for C or Pascal*	175	135
Greenleaf Communications *by Greenleaf*	185	138
C UTILITY LIBRARIES		
Blaise C TOOLS PLUS/5.0	129	99
Blaise Turbo C TOOLS	129	99
Blaise C TOOLS PLUS	175	135
C Food Smorgasbord *by Lattice*	150	109
C Utility Library *by Essential, 300 functions*	185	119
Greenleaf Functions *by Greenleaf Software*	185	139
COBOL LANGUAGE		
RM/COBOL *see Ryan-McFarland Prod*		
Microsoft COBOL Compiler	700	499
Microsoft COBOL Compiler *for XENIX*	995	795
Micro Focus COBOL *see Micro Focus Prod*		
dBASE SUPPORT		
BRIEF/dBRIEF *Brief for DBASE III*	275	Call
CLIPPER *from Nantucket*	695	375
McMAX *dBASE for MAC from Nantucket*	295	Call
Foxbase+ *from Fox Software*	395	Call
Foxbase+ Multi-User	595	Call
APPLICATIONS PLUS *Fox + Gellar*	499	299
QUICKCODE PLUS *Fox + Gellar*	295	170
QUICKREPORT *Fox + Geller*	295	170
QUICKENTRY *Fox + Geller*	Call	Call
The UI Programmer *Wallsoft*	295	244
The Documentor *Wallsoft*	295	244
dFlow *Wallsoft*	149	124
dBx *dBASE to C Translator by DESKTOP AI*	350	299
with Library Source Code	550	469
with Full Source Code	1500	1282
dBC *from Lattice maintains DBASE files*	250	195
with source	500	390
dBC III Plus *supports multi-user DBASE*	750	595
with source	1500	1195
DEVELOPMENT TOOLS		
BASTOC *by JMI, convert BASIC to C*	495	399
BASIC-C *BASIC's functions added to C*	175	139
Report Option *Softcraft Btrieve Report Gen*	145	128
Xtrieve *Softcraft Query Utility for Btrieve*	245	220
Code Sifter *Profiler by David Smith*	119	99
Dan Bricklin's Demo Program *Prototyper*	75	69
LMK *from Lattice, "make" like UNIX*	195	149
Microsoft Window Development Toolkit	500	365
ESSENTIAL PRODUCTS		
C Utility Library	185	119
Essential Graphics	250	183
Essential Comm Library	185	125
with Breakout Debugger	250	189
FILE MANAGERS		
Btrieve *by Softcraft, no royalties*	250	195
Btrieve Network *by Softcraft*	595	465
C-Tree *by FairCom - no royalties, source*	395	329
R-Tree *by FairCom-Report Generator*	295	245
C-Tree & R-Tree Combo *by FairCom*	650	541
dbVista *single user DBMS by Raima*	195	139
dbVista *multi-user DBMS*	495	399
Opt-Tech Sort *Can sort Btrieve files*	149	105
FORTRAN LANGUAGE		
RM/FORTRAN *by Ryan McFarland*	595	499
The Automated Programmer *by KGK*	995	949
FORTRAN Libraries *by Alpha Computer*	70	45
Microsoft FORTRAN *Links w/Microsoft C*	450	281
Microsoft FORTRAN *for XENIX*	695	546
Scientific Subroutine Package *by Alpha*	295	239
GRAPHICS		
Essential Graphics *Essential, no royalties*	250	183
GSS Graphics Development Toolkit	495	375
GSS Kernel System *by Graphic Software*	495	375
GSS Matatile Interpreter	295	235
Halo *by Media Cybernetics*	300	219
with Dr. Halo II	440	299
Halo for Microsoft *includes all fonts*	595	434
MICRO FOCUS PRODUCTS		
Micro Focus Level II COBOL *w/Animator*	495	445
Level II COBOL	349	314
Level II Animator	195	175
Micro Focus Personal COBOL	149	134
MODULA-2 LANGUAGE		
MODULA-2 Compiler Pack *by LOGITECH*	99	79
MODULA-2 Development Pack	249	199
MODULA-2 ROM Pkg & Cross RT Debugger	299	239
MODULA-2 Toolkit	169	139
MODULA-2 Window Pkg	49	39
OTHER LANGUAGES & UTILITIES		
Source Print *source code formatter*	97	75
Tree Diagrammer *source code diagrammer*	77	67
Microsoft MuMath *includes MuSimp*	300	199
Microsoft Pascal Compiler *Links w/M'soft C*	300	199
Microsoft Pascal Compiler *for XENIX*	695	546
Turbo Power Tools+ *by Blaise*	100	67
Advantage C++ *by Lifeboat Assoc*	495	435
PHOENIX PRODUCTS		
C/PAC *PforCe+ Pre-C*	495	299
PASM86 *Macro Assembler*	195	99
PDisk *Phoenix's new disk manager*	145	89
Plantasy Pac *six products New Price*	995	548
PFinish *EXE performance analyzer*	395	194
Plink86 Plus *Symbolic Debugger*	395	194
PforCe *vast library*	395	194
PforCe++ *Function Library for C++*	395	194
Plink86 Plus *Utilizes memory for overlays*	495	259
Pmaker *like UNIX "make"*	125	69
Pmate *with Macros*	195	88
Pre-C *UNIX "lint"-alike*	295	144
PTel *Binary File Communicator*	49	39
POLYTRON PRODUCTS		
PVCS Corporate *Source Code Control Syst*	395	309
PVCS Personal	149	109
PVCS Network	Call	Call
PolyMake *Complete Make Utility*	149	109
PolyLibrarian *Library Manager*	99	73
PolyLibrarian II *Library Manager*	149	109
PolyShell *UNIX-like Command Shell*	149	109
PolyXREF *Complete Cross Ref Utility*	219	169
PolyXREF *One language only*	129	99
PolyBoost *The Software Accelerator*	80	64
PolyDesk III *3rd Generation Desktop Org*	99	73
PolyDesk III *Add On Tools*	Call	Call
RYAN-McFARLAND PRODUCTS		
RM/FORTRAN *2 4 New*	595	499
RM/FORTRAN *UNIX or XENIX*	750	599
RM/COBOL *DOS*	950	799
RM/COBOL *UNIX or XENIX*	1250	999
RM/COBOL 85 *ANSI 85 COBOL*	1250	995
RM/SCREEN *for COBOL 85*	395	335
RM/NET +5 *COBOL & COBOL 85 Network*	300	249
SCREEN DESIGN		
Curses *by Lattice, UNIX screen designer*	125	99
with Source	250	199
Greenleaf Data Windows *New*	225	168
with source	395	297
Panel Plus *by Round Hill, no royalties New*	495	395
View Manager for C *by Blaise*	275	199
Vitamin C *by Creative Programming*	225	198
VC Screen *by Creative Programming*	100	81
Windowa for C *Varmont Creative Software*	195	149
Windowa for Data *includes Windows for C*	295	259
ZView *Data Management Consultants*	295	259
TEXT EDITORS		
Brief *from Solution Systems*	195	Call
Condor Editor *by Condor*	130	110
Edix *by Emerging Tech Multi-screen*	195	158
Epsilon *by Lugaru Software, like EMACS*	195	148
FirsTime *by Spruce Technology, C syntax*	295	229
Kedit *by Mansfield, similar to Xedit*	125	99
LSE, the Lattice Screen Editor *Multi Wind*	125	100
Vedit *by Compuview*	150	99
Vedit Plus *by Compuview*	185	129

PC BRAND™ SPEAKS YOUR LANGUAGE

HALO
Graphics Tools for Software Developers

When choosing your graphics tools for software development, performance is crucial. The best proof of HALO's superior performance is in the number of Independent Software Vendors (ISVs) that develop and distribute HALO-based applications. Over 190 ISVs selected HALO because HALO out performs the rest. HALO is easier to program and shortens time-to-market. HALO is complete with over 190 functions, 17 programming languages, and HALO supports a wider range of devices—over 110.

Since 1981 HALO has been the industry standard library of graphic subroutines for the PC. HALO has an installed base of 60,000+ end users and hundreds of site licenses.

A single copy of HALO includes all device drivers, your choice of one compiler binding, LearnHALO (an interactive tutorial), free 800 # technical support, and the license to use HALO on one machine. Flexible, practical licensing terms are available for ISVs and "Sites."

	List	PC Brand
Halo	**$300**	**$219**
with Dr. Halo III	**$440**	**$299**
Halo for Microsoft	**$595**	**$434**

GREENLEAF LIBRARIES
Functions

C source, assembler source, and binary libraries of 225 functions for many compilers. Emphasizes tight functional groupings to minimize loading code which your application may never use. Manual's 250 pages help select functions, as do demos, bulletin board.

A sampling. *DOS*: extensions for file and directory manipulation. *Screen*: select mode, page, monochrome or color, palette; cursor shape, positioning, clearing and scrolling; pixel get and put. *Strings*: efficient operations to add, delete, sort string pointers for top speed. *Other*: graphics primitives, keyboard status, function key assignment, time/date, read registers, get memory size, peek and poke. Specify S0770 & Compiler.

List **$185**, Here **$139**

Communications

Communicate from within your own C programs! Over 120 functions and demo programs in C and assembler source to set up interrupt-driven asynch communications for up to 16 channels. Up to 9600 baud, ASCII or binary, any parity or word length, 8250 UARTs, Xon/Xoff and Xmodem, WideTrack receive. Goodbye separate communications software. Specify compiler.

List **$185**, Us **$139**

The AUTOMATED PROGRAMMER
Enter Mathematical Notation Directly

A programming system for numerical computation that enables a computer to recognize and process mathematical, engineering, and scientific specifications. Using the Two-dimensional (2D) Text Editor, input computational formulas directly using conventional mathematical notation (e.g., integral, summation, numerator-over-denominator division, matrix inverse, dot and vector products, etc.) and technical English. The description of the problem solution (program) is expressed at such a high level that it approaches the ideal of an executable specification., i.e., for many problems, *the specification is the program*. A correct program can be achieved many times faster than by current programming methods. Verification and debugging are often reduced to proof reading—"If it looks right, it is right."

The Automatic Programmer translates 2D programs into a target language, permitting easy interfacing with existing program libraries. The currently available target language is FORTRAN.

Computational results may be embedded in complex 2D text and graphic "IMAGE" formats using intuitively obvious (WYSIWYG) control.

List **$995**. PC Brand **$949**

BTRIEVE *B-tree File Manager Plus Add Ons*

If networks are on your horizon, betting your future on Btrieve as the one file manager for your C, Pascal, BASIC, and COBOL projects looks like a smart move. Reason? Novell bought Btrieve's creator.

Btrieve's function library takes complete charge of all file creation, indexing, reading, writing, insertion, deletion, space recapture, forward and backward searching. Its balanced-tree indexing scheme finds any key in a million in four or less accesses. Files may have up to 24 indexes, fixed record length to 4090 characters, variable length to 64k, indexes up to 255 characters, files of 4 billion bytes.

List **$245**. Us **$195**. Network Version List **$595**. Ours Only **$465**. And ask about Xtrieve for Btrieve file inquiry, and Rtrieve for report writing. All three in versions for any network that supports the MS-DOS 3.1 file sharing function.

PANEL PLUS *Screen Favorite Has Library Source*

There are no screen design and data entry tools quite like Panel Plus. With it you design a screen under program control, use Panel's utility to "run" and test it field by field, then pass it to Panel's code generator which delivers C source code to work with as you please. The code calls Panel Plus's function library, but now *the library comes in source*, so everything is portable and changeable.

Has every imaginable feature. A screen can have 1000 fields stacked 127 levels deep. Each field can be boxed, colored, multi row, word-wrapped, scrolled four ways, linked to help messages, matched to a picture, validated after data entry—it's exhaustive.

Operates in graphics mode via interfaces of graphics products it supports. Handles EGA's 43 line screen. Adaptable to various keyboards, screens, operating systems. Major tool with years of evolution. List **$495**. Here **$395**.

GSS GRAPHICS SYSTEM
Leave the Device Driving to GSS — ANSI CGI STANDARD

For serious applications stick to the tools that stick to the standards. Not the least of reasons why GSS™ has emerged as the pre-eminent graphics toolmaker is that it has always conformed to ANSI standards.

At the heart of the system is the CGI standard Development Toolkit. It has all language interfaces and device drivers for keyboards, mice, joysticks, tablets, printers, plotters, cameras. The drivers completely insulate your application from concern for device idiosyncracy.

GSS Kernel™ conforms to ANSI's GKS 2b and has all its drivers and language bindings. Macro level tools to draw, color, segment, transform, store and recreate an object. The Metafile Interpreter reads ANSI CGM files with full CGI capability for recreation on various devices.

Quality software? IBM thinks so. They sell GSS under their own label. Royalties. Needs 256k.

Ask for	List	PC Brand
CGI Dvlpmt Toolkit	**$495**	**$375**
Kernel System	**$495**	**$375**
Kernal for IBM RT	**$795**	**$645**
Metafile Interpreter	**$295**	**$235**

BLAISE C TOOLS PLUS/5.0

C TOOLS PLUS/5.0 from Blaise Computing Inc. helps you to quickly build professional applications using the full power of Microsoft C 5.0 and QuickC. Now you can concentrate on program creativity by having full control over DOS, menus, interrupt service routines, memory resident programs, fast direct video access, windows, printer and keyboard control, and more!

Blaise Computing's attention to detail, like the use of full function prototyping, cleanly organized header files, and a comprehensive, fully-indexed manual, makes C TOOLS PLUS/5.0 the choice for experienced developers as well as newcomers to C.

C TOOLS PLUS/5.0 prebuilt libraries are ready to use with either QuickC or the Microsoft C 5.0 command line environment. Complete documented source code is included so that you can study and adapt it to your specific needs.

	List	PC Brand
C TOOLS PLUS/5.0	**$129**	**$ 99**
Turbo C TOOLS	**129**	**99**
C ASYNCH MANAGER	**175**	**135**
Turbo POWER TOOLS	**99**	**75**
Turbo ASYNCH PLUS	**99**	**75**

POLYTRON VERSION CONTROL
Source Code Control for Any Language

PVCS allows programmers, project managers, librarians and system administrators to control the proliferation of revisions and versions of source code in software systems. Independent programmers, the leading software publishers and LAN companies, and hundreds of Fortune 1000 companies rely on PVCS to store and retrieve multiple revisions of text. It maintains a complete history of revisions as an "audit trail", generates status reports, and uses intelligent "difference detection" to minimize disk space for each new version.

On Corporate and Network PVCS simultaneous changes to a module are merged into a single new version. If changes conflict, the user is notified. The 'Logfiles" used to track changes are interchangeable between any PVCS product.

Corporate PVCS is for multiple programmers. It includes "branching" to maintain code when programs evolve on multiple paths. Personal PVCS offers most of the power and flexibility of corporate PVCS, but excludes multiple programmer features. Network PVCS is the Corporate version for LANs. File locking and security levels can be tailored to each project.

PolyMake Still using a prehistoric Make? Step up to PolyMake, the most popular and powerful Make utility. Most flexible macros of any Make. Now integrated with PVCS and PolyLibrarian for faster performance and precise configuration management.

Ask for	List	PC Brand
Personal PVCS	**$149**	**$109**
Corporate PVCS	**$395**	**$309**
Network PVCS	**Call**	**Call**
PolyMake	**$149**	**$109**

30-DAY MONEY-BACK GUARANTEE

*We refund the purchase price of any product returned within 30 days in entirely resalable condition. **You can even try out many programs themselves.** Ask your salesperson for details. There's just nothing stopping your buying from PC Brand.*

NEW VERSION!

C-WORTHY INTERFACE LIBRARY

The C-Worthy™ Interface Library wraps an entire user interface around your application. Its full power can be summoned by only a few high level calls. Sound exaggerated? A single function call can set up a complete text editor in a screen window. Recently acquired by Solution System, over 600 pages of Documentation, Turbo and Quick C version and a complete Interface Library have been added.

- High level calls pop menus and scrollable choice lists to the screen, restoring the background when dismissed.
- Windowing facilities open portholes of up to screen size for viewing virtual screens larger than the physical screen.
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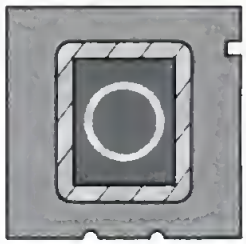

PC ADVISOR

Help in boosting the resolution of the IBM EGA, in finding a real dictionary on floppies, and in printing pamphlets with correctly ordered pages.

DEFINITIONS TOO

Could you please tell me if anyone markets a dictionary with definitions on floppy disks? I have seen them on compact disk but don't want to invest in a CD player.

J. Dean
Huntington, West Virginia

There is such an animal, and as long as you have plenty of spare room on your hard disk you should find it a pleasure to use. Funk and Wagnall's Standard Desk Dictionary *($79.95; Inductel, Saratoga, CA; (408) 866-8016) ships on 16 floppies and occupies about 5.5 MB of hard disk storage.*

But despite its disk-hungry nature, the Funk and Wagnall's *dictionary can pop up definitions faster than you can say "Mississippi," thanks to Inductel's fast Knowledge Access System look-up engine. Though Microsoft's CD-based product,* Bookshelf, *has a wider range of information than Inductel's dictionary and leaves your hard disk free for other chores, you'll find the Inductel dictionary to be faster. Running on an 8-MHz AT, the Inductel dictionary consistently pops up definitions in less than 1 second, compared with the several seconds* Bookshelf *requires.*

Aside from phonetic word representations, the 100,000-word dictionary includes the complete contents of the Funk and Wagnall's College Dictionary. *The program is not memory resident, however, so you won't be able to look up a word without exiting your current application unless you use a windowing environment. Inductel currently recommends using the program with the* DESQview *windowing environment and will support* Microsoft Windows *in the future.*

*Automated Language Processing Systems is also shipping a dictionary on floppy disks—*ABC Word *($150; Provo, Utah; (801) 379-2300).* ABC Word *packs fewer words than Inductel's product—87,000 if you include the different forms of each word—but it can run RAM resident if you so choose. The dictionary, based on the Merriam-Webster dictionary, occupies slightly more than 1MB of hard disk storage and uses about 214K RAM running memory resident.*

HI-RES AUTOCAD

Until recently I was happy running *AutoCAD* on my IBM PC AT with an IBM EGA card and NEC MultiSync monitor. However, the high-performance graphics boards hitting the market have left me hungry for better resolution. Is there any way I can boost the resolution of my system for design work without coughing up the money for a new graphics board?

Charles W. Doty
Lafayette, Indiana

■ Despite its disk-hungry nature, the *Funk and Wagnall's* dictionary can pop up definitions faster than you can say "Mississippi."

As it turns out, the 32-pin feature connector on the IBM EGA board may come in handy after all. The Photon Maxer (Personal Computer Graphics Corp., Culver City, Calif.; (213) 216-0055) installs into the feature connector of any EGA board and boosts graphics resolution to anywhere from 640 by 480 to 800 by 600 pixels, depending on the adapter. The Photon Maxer will boost your IBM EGA's resolution to 800 by 512 pixels.

Of course, you need a multiscanning monitor (your MultiSync should do nicely) and software drivers to take advantage of this heightened resolution. PCGC is currently shipping the Maxer with high-resolution drivers for AutoCAD, VersaCAD, CADVance, Generic CADD, Prodesign II, Ventura Publisher, GEM Desktop Publisher, *and* Microsoft Windows.

At $159, the Maxer isn't cheap. But if you're not willing to upgrade just yet to an extended EGA or high-performance graphics board, it may be what you need to buy some time for your aging EGA.

LOW-COST PAMPHLETS

Our insurance company currently commissions a local printer to print the benefit pamphlets we send to our customers. We would like to print them ourselves on our HP LaserJet II, but we've been unable to find software that can do the job.

■ PC ADVISOR

What we need is software that can print two pages side by side, on each side of each page of output. The pages should be printed so that, when folded, the pages of the pamphlet appear in the correct order.

Henry Ng
Burlington, Ontario
Canada

This is one of those rare occasions when the best solution to a problem is also the least expensive. Pamphlet, *a $15 shareware program, offers exactly what you need and works with the LaserJet.*

Pamphlet *accepts any ASCII file as input, so you won't have to learn a new word processor or desktop publishing system. The program automatically switches the LaserJet into landscape mode and changes to the small internal font before printing begins. Once it completes printing on one side of each page of output, it instructs you to reinsert the stack upside down in the LaserJet for printing on the other side. The finished product is a stack of pages that, when folded and stapled, forms a correctly ordered pamphlet.*

You should be able to download the program from any major bulletin board, but you can also order it by mail from Martin Beattie, 9190 Rolling Tree Ln., Fair Oaks, CA 95628.

■ *Pamphlet* accepts any ASCII file as input, so you won't have to learn a new word processor.

If you want to spruce up your pamphlets with graphics and unusual fonts, you'll need a desktop-publishing system. At the low end, Software Publisher Corp.'s First Publisher *(Mountain View, Calif.; (415) 962-8910) has basic page layout and text-graphics integration for only $99. A step up the ladder,* PageMaker *($695; Aldus Corp., Seattle, Wash.; (206) 622-5500) is a full-featured desktop publishing system that maintains ease of use. For the widest range of features, go with* Ventura Publisher *($895; Xerox Corp., El Segundo, Calif.; (800) 822-8221).*

None of these packages will automatically prepare a document for saddle binding, as will Pamphlet, *but they will give you the flexibility to manually lay out the pages in the correct order yourself.*

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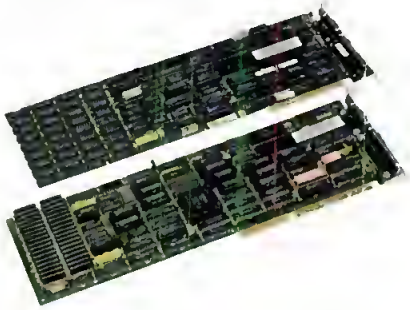

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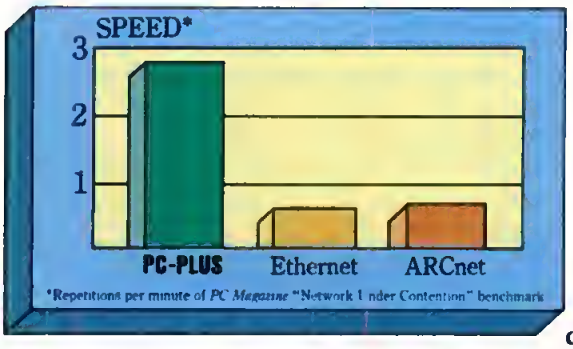

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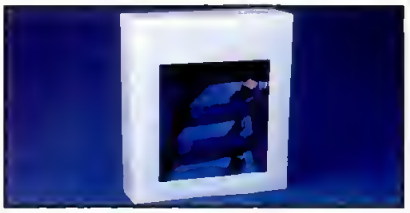

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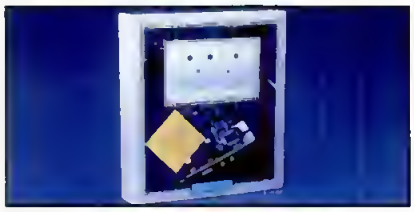

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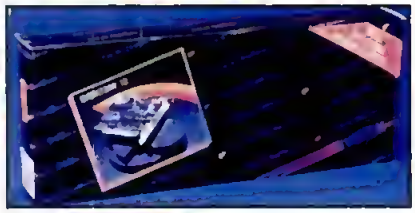

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PC MAGAZINE

FIRST LOOKS

CAUTION: STEEP UPGRADE PATH AHEAD

OS/2—Ready to Take on DOS—Has a Familiar Feel

PC HANDS ON

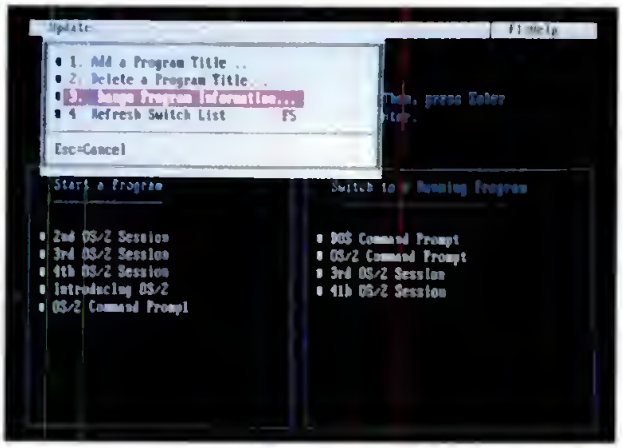
BY CHARLES PETZOLD

For more than 6 years, since the introduction of the original IBM PC, DOS has reigned unchallenged. Although now old and feeble and unable to face the challenges of the nineties, DOS has kept on kicking with the help of various life-support systems and applications that succeed mostly by ignoring it. But we need no longer pretend that DOS is still fit for service, because DOS now has a successor—Operating System/2.

For DOS users, OS/2 is a fairly smooth upgrade path: It uses the same file system as DOS and can be installed on a hard disk running under DOS without reformatting. Many software manufacturers are expected to release OS/2 versions of existing DOS programs within the next year. During the transition from DOS to OS/2, users can work with existing DOS programs and new OS/2 programs on the same machine without rebooting.

Until the graphical interface of the Presentation Manager becomes available in OS/2 1.1, the command line interface of OS/2 1.0 will make users of DOS feel right at home. Most of

(continues on page 34)



The Program Selector, called by hitting the Ctrl-Esc combination, lets you start or get into one DOS Mode or move among several OS/2 Mode sessions. The Update command lets you add a session, change its path, or remove it as an option.

VM/386 Multitasks Existing DOS Applications Far Beyond 640K

PC HANDS ON

BY BARRY SIMON

The 80386 is a sweet chip. My dream operating system for it has three aspects: it should multitask old-fashioned DOS applications; it should provide support for specially written applications to run in the large address space allowed by the 386; and it should provide an ample array of kernel services—not only systems functions like disk caches and RAM-disks, but also a rich batch language and even hooks to TSR pop-ups.

VM/386, from Intelligent Graphics Corp., is a new entrant in the current sweepstakes for fully functional 80386 environments. It is an exciting program that will run on the Compaq Deskpro 386, the Intel Inboard 386, and compatibles. It does not run on IBM PS/2 Model 80s. Its most serious competition will be *Microsoft Windows/386* (see First Looks, page 33, *PC Magazine*, December 22, 1987) and the forthcoming *DESQview 386*.

Alas, the initial release has no provision for running large-code 386 programs. IGC also sells a 386 extender called X-AM, which will be supported in a future version of VM/386. Two programs that are being written under X-AM are *FoxBASE* and *Matlab*. Since there is no standard for native 386 programs, programs written with other extenders will probably not run under VM/386, and OS/2 will probably never coexist with it.

What VM/386 does well is

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Photograph, Thom O'Connor

OS/2 Ready

(continued from page 33)

the DOS internal and external commands have been duplicated under OS/2 with a few enhancements. For example, the OS/2 versions of the DIR, DEL, MKDIR, RMDIR, TYPE, and VOL commands can accept multiple arguments, such as

```
DIR *.WS *.DOC
```

OS/2 also includes several new commands. One of them is DETACH. This allows a program that does not require keyboard input to run in the background. When you execute

```
DETACH CHKDSK
>CHKDSK.OUT
```

the OS/2 prompt returns immediately. You can then do something else while CHKDSK is running and later look at the output using the TYPE command.

OS/2 has a somewhat enhanced batch file language, but the enhancements mostly involve interpreting return codes from commands and programs. Batch files that run under OS/2 have a .CMD rather than a .BAT extension.

Error messages from OS/2 commands are wordier and less cryptic. You'll see complete sentences such as "The system cannot find the file specified" rather than "File not found." All error messages from system commands are prefaced by a number. If you execute

```
HELP number
```

OS/2 displays more information about the error with suggestions for remedies.

The most convenient aspect of OS/2 for users is in the support of multiple full-screen "sessions," each of which can run a different program.

OS/2 supports up to 12 "OS/2 Mode" sessions for running programs written for OS/2. You can switch between sessions using the Alt-Esc key combination.

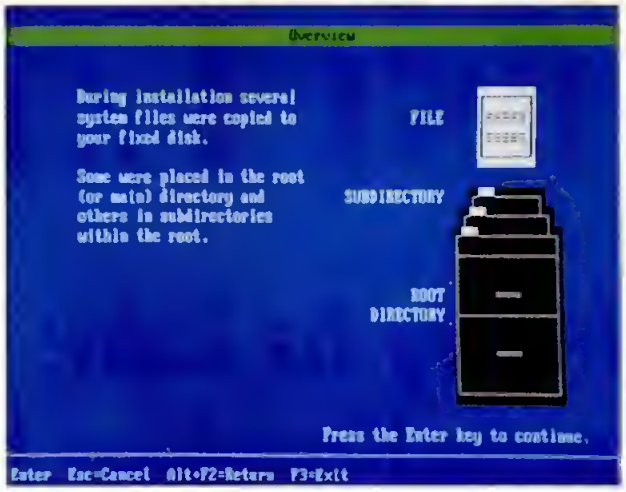
You start up a new session from the OS/2 Program Selector, which you can view at any time by pressing the Ctrl-Esc key combination. The Program Selector includes context-sensitive help windows and works with both the keyboard and the mouse. (IBM's OS/2 1.0 package includes device drivers for the IBM, Microsoft, Mouse Systems, and Visi-On mice.)

The "Start a Program" list at the left side of the Program Selector lets you start up a new OS/2 session with a specified program. The list always includes the option "OS/2 Command Prompt," which starts the OS/2 command processor (called CMD.EXE) and leaves you at the OS/2 prompt. You can add other OS/2 programs to this list through the Update menu at the top of the screen.

The "Switch to a Running Program" list at the right of the Program Selector lists all the sessions currently running. You can switch to one of these programs by selecting it with the keyboard or the mouse.

In office environments, the Program Selector can replace batch file menu systems that currently allow users to run programs without coming into contact with the operating system command line. But the Program Selector is certainly not a "DOS shell" utility and does not include any menu-driven alternatives to the OS/2 commands. The Presentation Manager component of OS/2 1.1 is expected to have a complete menu-based command system.

In addition to the 12 OS/2 Mode sessions, OS/2 also supports one "DOS Mode" session for running existing DOS programs. (Microsoft previously called this the "DOS Compatibility Box" or the "DOS 3*X*



The "Introducing OS/2" tutorial is one step above "Sesame Street," and a thousand steps away from offering useful information on OS/2.

But What Are You Going to Do with It?

Running four or five sessions on your AT is pretty heady stuff the first time you do it. But after you've played tricks with five directories at once, there's little you can actually do with OS/2 right now. Despite the nationwide Manhattan Project that began last April when IBM announced the specs for OS/2 and the toolkit to help programmers write applications, there are no applications ready to greet the arrival of OS/2.

Due out in coming months are OS/2 versions of *R:base*, *Paradox*, *WordStar 2000*, and *Informix-SQL*.

Most software publishers, including Ashton-Tate, WordPerfect, and even Mierosoft, say they will release OS/2 versions of their applications, but they refuse to say when. The general feeling is that there will be little demand until the Presentation Manager ships.

The question of how publishers will sell two versions of the same application is a sensitive issue. Publishers don't want to sell two copies of a program for one price, and consumers don't want to pay the full price for what they see as an upgrade.

So far, Lotus is the only publisher planning to provide an OS/2 version at no extra cost: when *1-2-3* Release 3 ships in the spring, it will be in both formats for one price, as will Lotus's new textbase, *Agenda*.

Curiously, Mierosoft doesn't plan to release any OS/2 applications until the Presentation Manager is ready next fall. **—Gus Venditto**

Getting Started with OS/2

The IBM version of OS/2 1.0 runs only on the IBM PC AT, the PC-XT Model 286, and the PS/2 Models 50, 60, and 80. It is available in both the 5¼-inch (1.2MB) and 3½-inch (1.44MB) diskette formats. Because OS/2 requires an 80286 or 80386 microprocessor, it will not run on the 8088-based PC or PC-XT, nor on the 8086-based PS/2 Models 25 and 30.

Although OS/2 was developed under the IBM/Microsoft Joint Development Agreement, it remains a Microsoft product. (Microsoft calls the operating system MS-OS/2, but almost no one else does.)

The IBM version of OS/2 1.0 may run on some AT compatibles, but it will not run on all machines that can currently run the IBM version of DOS. Normally the machine's ROM BIOS hides small differences in hardware from the operating system, but OS/2 does not use the ROM BIOS and must itself contain all the hardware-dependent code.

Computer manufacturers other than IBM can license OS/2 from Microsoft and adapt it to their specific hardware. (This is basically the same way DOS is marketed.) Several other major computer manufacturers (such as Compaq and Zenith) are expected to release versions of OS/2 in the coming months.—**Charles Petzold**

Photograph: Thom O'Connor

Box.") The DOS Mode session is an application environment ostensibly compatible with DOS 3.3 with the SHARE program loaded. OS/2 does not multitask existing DOS programs, and the programs cannot use memory beyond 640K. Options in the CONFIG.SYS file allow you to reduce the size of the memory available for the DOS Mode session or eliminate it entirely.

You can switch to DOS Mode by selecting the "DOS Command Prompt" item from the Program Selector. Most existing programs that run under DOS will run fine in the DOS Mode session, but some will not. The problem programs include those that use the 80386 microprocessor in protected mode (such as *Microsoft Windows/386*), those that use extended memory, and those that rely on some undocumented DOS function calls or specific memory locations within DOS. (The undocumented DOS function calls that DOS RAM-resident programs most commonly use are supported.) Because the DOS Mode session is suspended when a user switches to an OS/2 Mode session, communications programs running under DOS Mode can lose incoming data if the DOS Mode session is not kept active.

We tested *dBASE*, *WordPerfect*, *Microsoft Word*, *Microsoft Windows* 2.0, and *SideKick* in DOS Mode without problems. *Microsoft Windows* 1.03 and Lotus's *Metro* wouldn't run. *Software Carousel* and *DESQview* hung the entire system.

OS/2 device drivers must run in both protected mode and real mode. Hence, most existing DOS device drivers will have to be replaced with OS/2 versions. External hard disks and tape units that require device drivers to be listed in the CONFIG.SYS file cannot be used under OS/2 until the manufacturers supply new drivers.

The OS/2 User's Reference looks neat and polished, with new syntax diagrams (see the sample on page 36) and a helpful glossary ("code page: a defined set of alphanumeric, graphic, and control characters"), but it is almost entirely reference material. IBM has apparently given up on providing a user tutorial. The manual has a good section on CONFIG.SYS statements, but almost nothing on hard disk partitioning except for a description of FDISK.

The installation of OS/2 on a hard disk is easier than the installation of some recent application programs I've seen. The IBM installation program takes about 10 minutes and transfers about 130 files to the hard disk. Of these files, about 60 are stored in the root directory and the rest are stored in three new subdirectories.

If your hard disk is currently formatted for use by DOS, installation of OS/2 does not require reformatting. The two hidden files that make up DOS are replaced by OS/2 hidden files with the same names.

OS/2 1.0 requires at least 2MB of memory: 640K of conventional memory normally used for DOS, plus at least 1,408K of extended memory. If you plan to run OS/2 without the DOS Mode session, you can reduce the extended memory requirement to 896K, for a total of 1.5MB.

Due to the imperfect nature of the DOS Mode session under OS/2, it is likely that you'll need to boot up DOS from time to time to run troublesome programs. IBM recommends making a floppy disk from which to boot DOS before you install OS/2.

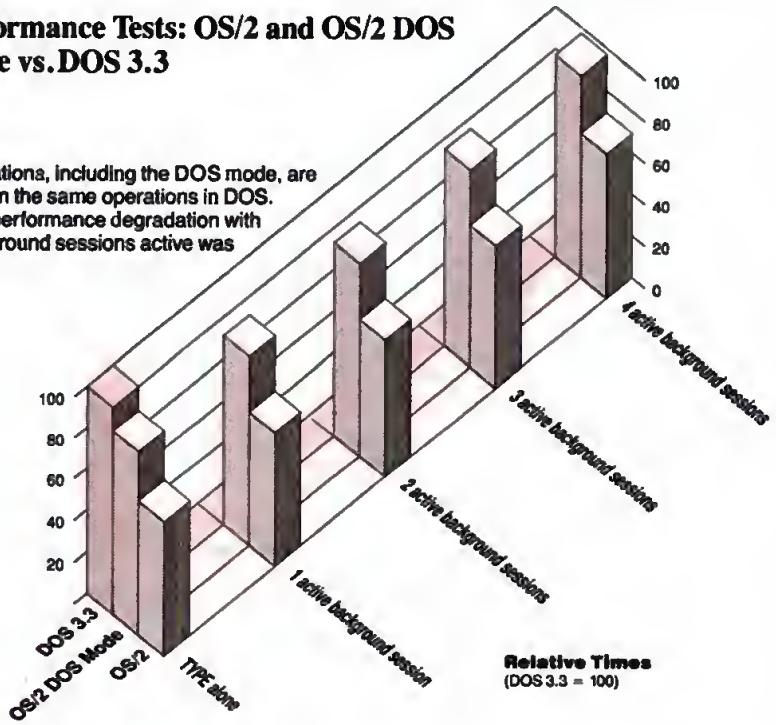
Although IBM's installation process is easy to use, it is disturbingly slow, mostly because it works from an interpreted script file. One of the first messages you see when you boot up the installation disk says, "One moment please." The delay that follows far exceeds my definition of a "moment." A sluggish installation program is not the right way to introduce OS/2.

After installation is complete, the hard disk contains a few worthless files created as a by-product of the installation process. (You have to check

(continues on page 36)

Performance Tests: OS/2 and OS/2 DOS Mode vs. DOS 3.3

OS/2 operations, including the DOS mode, are faster than the same operations in DOS. Surprisingly, performance degradation with several background sessions active was minor.



Performance Times
(Times given in seconds)

	TYPE alone	TYPE, 1 active background session	TYPE, 2 active background sessions	TYPE, 3 active background sessions	TYPE, 4 active background sessions
DOS 3.3	28.4	N/A	N/A	N/A	N/A
OS/2 DOS mode	25.1	26.8	26.3	26.9	27.8
OS/2	18.2	18.4	18.7	19.4	19.7

The TYPE performance test generates a DOS TYPE listing from a 65K text file. To keep background sessions active, a batch file performs the same operation in a loop. The tests were performed on an IBM PS/2 Model 60.

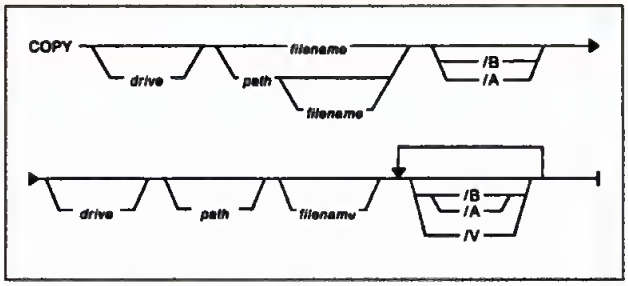
N/A—Not applicable: DOS 3.3 does not run background sessions.

OS/2 Ready

(continued from page 35)

Appendix H in the User's Reference to determine which files can be deleted.) Also copied to the hard disk are superfluous driver files, such as nine different 16K mouse drivers. Too many files end up in the root directory when they could be stored in a subdirectory.

Although it is possible to leave DOS on the hard disk and boot OS/2 from a floppy disk, the installation program does not include this option, and the manual does not describe how to do it. The installation program always installs OS/2 in the primary DOS partition of the hard disk (drive C:). It does not appear possible to install OS/2 and DOS in separate bootable partitions.



The OS/2 manual introduces a new syntax diagram that replaces the cluttered format used by DOS manuals and complements the manual's descriptions. Most OS/2 commands are familiar DOS commands, but some have new parameters.

IBM's OS/2 package also includes a dopey "Introduction to OS/2" program. This program's presence on your hard disk provides an opportunity to execute your first protected-mode DEL and RD commands and to learn how to remove a program from the Program Selector.

It's been over 3 years since the introduction of the IBM PC AT. After waiting all this time for a protected-mode successor to DOS, we deserve an "Introduction to OS/2" program that is nothing less than spectacular. When OS/2 1.1 is released in October, I want to see an "Introduction to the Presentation Manager" program that makes up for this deficiency and is truly worthy of the operating system under which it is running.

OS/2 is habit-forming. Even when the only programs you can run in the OS/2 Mode sessions are OS/2 commands, the convenience of session switching with the Alt-Esc key soon becomes natural and addictive. You can easily imagine how efficiently you could work with a few good OS/2 programs all loaded up and ready to use.

Now that OS/2 is here, the next step is for software developers to start getting the applications out.

OS/2 in a Nutshell

OS/2 is a single-user multitasking operating system that uses the protected-mode operation of the 80286 microprocessor. Protected mode gives programs written for OS/2 access to the full 16MB memory space of the 80286 and allows the operating system to implement safe and efficient multitasking with protection against system crashes.

The facilities available in OS/2 for use by application programs are more reminiscent of minicomputer and mainframe operating systems than of DOS. OS/2 includes support for virtual memory (the use of disk space for overflow from available memory), for running multiple threads of execution in a single program, and for several forms of interprocess communication that allow programs to transfer data among themselves.

Although OS/2 1.0 (sometimes called the OS/2 Kernel) is a complete operating system in itself, various components to enhance the functionality and user interface of OS/2 will become available over the next year. The most important of these components is the Presentation Manager, which is part of OS/2, Version 1.1, and slated for release in October 1988.

The Presentation Manager will be a graphical windowing environment with a user interface derived largely from *Microsoft Windows*, Version 2.0, and a Graphics Programming Interface (GPI) adapted from IBM's mainframe graphics systems. The Presentation Manager is expected to become the primary environment for new applications developed specifically for OS/2.

—Charles Petzold

FACT FILE

Operating System/2, Standard Edition 1.0
IBM Corp.
Consult your local authorized IBM dealer.
List Price: $325; upgrade from DOS 3.0 or later, $200.
Requires: IBM PC AT, PC-XT Model 286, or PS/2 Model 50, 60, or 80; hard disk with 5MB available space; one 5¼-inch 1.2MB floppy disk drive or 3½-inch 1.44MB floppy disk drive; 2MB of memory (1.5MB if DOS Mode session is not required).
In Short: Move over, DOS: OS/2 is here and ready to begin a new chapter in the history of the PC. Not copy protected.

CIRCLE 446 ON READER SERVICE CARD

VM/386

(continued from page 33)

multitasking. Like my cleaning service, VM/386 doesn't do windows. Rather, it sets up multiple full-screen "virtual machines" that think they are ATs running standard DOS programs. Each virtual machine can have up to a full 640K. The VM kernel itself doesn't take any memory from these individual machines, although each machine must have a small (5K) resident program loaded.

Each VM can have its own CONFIG.SYS and AUTOEXEC.BAT; you can save profiles for individual machines and even save a startup file that automatically loads a number of virtual machines when you run VM/386. If you terminate one of these sessions, the memory will become available for new sessions.

Each session can be assigned its own allotment of EMS and extended memory, subject to the restrictions of your total RAM. While the kernel doesn't take anything away from the 640K maximum that each VM can have, it does take 640K from the total RAM pool. In addition to its DOS memory (which can be less than 640K if you wish), each VM needs memory to virtualize the video (up to 128K for standard EGA support).

At any time, the SysReq key brings up the VM manager, which allows you considerable control of system resources. I simulated a crash in a virtual machine by writing a nonsense address to the keyboard hardware interrupt. SysReq still brought up the control panel, and I could reset the crashed VM without affecting the other sessions.

There are two kinds of hardware under VM/386: exclusive devices and floating devices. The former remain attached to an individual virtual machine while the latter can be used simultaneously by all. For example, your disks and the primary monitor are floating. No attempt is made to handle printer conflicts, and the printer ports must be assigned exclusively to a single machine.

With one class of exceptions, VM/386 was able to handle any program that I tried to run with it. At one point I had

(continues on page 38)

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PC Emcee Runs Shows by Remote Control

PC HANDS ON

BY WINN L. ROSCH

Making images on your PC is fast, easy, and colorful. But the old-fashioned slide show still has its advantages, such as push-button control and technology that allows you to combine hi-fi sound with images.

PC Emcee bridges the gap between the two presentation technologies by combining many of the familiar aspects of traditional audiovisual presentations with the PC's ability to generate and control images.

The PC Emcee package differs from other presentation programs in that it combines a special hardware unit—the Presentation Coprocessor—with its software. This sturdy metal 2½- by 8- by 7-inch box links to your PC through a standard serial cable, to the remote control with a wireless infrared link, and to other accessories through cables.

As with other presentation packages, PC Emcee comprises two parts—a run-time module (the Player) that requires little training to use, and a program to create and alter shows (the Script Editor), which requires effort to learn and will seem easy only to programmers. It allows 27 transition effects (cuts, dissolves, and so on) and complete control of the pacing of each image change in the show.

Although PC Emcee includes a library of images, it does not actually create anything. Images for presentation can be generated by Versions 4.0 or later of Computer Support Corp.'s *Diagraph* or *Picture Perfect*, converted from standard bit-based image files, or captured from the screen. PC Emcee does not, however, include an image-capturing program.

The Presentation Coprocessor allows you to synchronize sound, using either time code or tone cues. Normally, you'll prepare a single-channel sound track and use the other channel of a stereo machine to hold time code. The PC Emcee editor allows you to specify time codes to change images to the frame (1/30 of a second).

The image quality of the PC Emcee system is superb—up to the maximum resolution and color allotment of a 256K EGA card, which is required in order to use the system. Moreover, it's one of the quickest presentation systems around. PC

The remote control device allows you to control your presentation from anywhere in the room; you can hook up a cassette recorder to add audio to your show that PC Emcee can synchronize to the display.

Photograph: Thom O'Connor

PC MAGAZINE FACT FILE

PC Emcee
Computer Support Corp.
2215 Midway Rd.
Carrollton, TX 75006
(214) 661-8960
List Price: $695
Requires: 512K RAM, EGA with 256K. Hard disk recommended.
In Short: A presentation system that combines real-time presentation or animation software, a hardware coprocessor, and a hand-held remote control for up to 250 remote devices with synchronized sound.

CIRCLE 443 ON READER SERVICE CARD

VM/386

(continued from page 36)

DESQview, *Windows*, *GEM*, *Software Carousel*, *Microsoft Flight Simulator*, and *SideKick* loaded concurrently, each in its own session. The only exceptions are programs that access the disk through the BIOS rather than DOS. Examples are CHKDSK with the /F parameter, disk optimizing programs, certain DOS file managers like *QDOS*, and disk utilities like those from Norton and Mace. But your disk is still a DOS disk, and you can boot DOS without running VM/386 when you need to use such programs. While I didn't test this, IGC claims VM/386 will run with IBM Token Ring and 3Com networks.

There are performance penalties associated with multitasking. Running a task in the background has got to give the foreground task less CPU time, although if your foreground task isn't computation intensive that may not matter.

In addition, there will be overhead associated with the VM kernel monitoring what is going on. The overhead associated with the kernel itself is rather small for computational tasks (only about 5 percent), but it is larger—about 25 percent—for disk and monitor activity. VM does a very good job of not giving CPU time to idle tasks—tests for one foreground machine with nothing in the background are essentially the same as the times for ten 128K idle sessions.

But when you begin to use multitasking, performance deteriorates dramatically. It took the disk manager *X-Tree* 6 seconds to load under naked DOS, 143 seconds to load underneath a single VM/386 session, and 310 seconds if I was simultaneously copying a collection of files in a second session.

[*Results for PC Labs benchmark tests show steady performance degradation as the number of multitasking sessions is increased. We're not printing these results since the numbers are not reproducible: it's impossible to predict which tasks were being performed in the background while the test was running in the foreground. Overall, performance degraded by around 50 percent for each test every time another active virtual machine was added. —Ed.*]

The current version of VM/386 is weakest in the kernel services that it offers. Other than the control functions there is a disk cache, but that's it.

VM/386, Version 1.00, is an exciting product but one with certain restrictions that you'll need to be sure you can live with. Version 2.0 should be fantastic. PC

PC MAGAZINE FACT FILE

VM/386, Version 1.00
Intelligent Graphics Corp.
4800 Great American Pkwy.
Santa Clara, CA 95054
(408) 986-8373
List Price: $195, including free upgrade to Version 1.01 and 6 months' support.
Requires: Compaq 386, Intel Inboard 386, or compatible 386 PC, with 2MB minimum RAM (will not run with IBM PS/2 Model 80).
In Short: An exciting multitasking operating system for 386 computers that allows you to set up multiple "virtual machines" that behave like ordinary ATs running existing DOS applications. Not copy protected.

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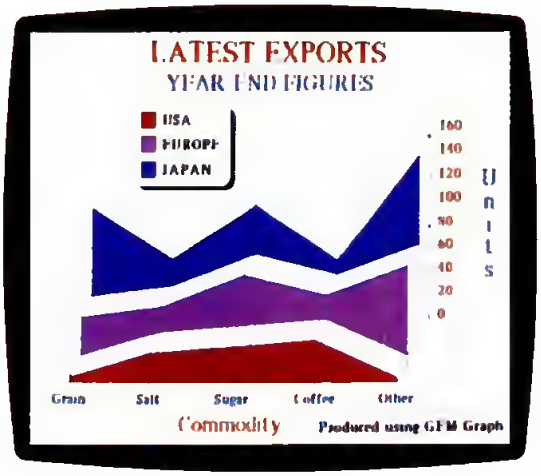

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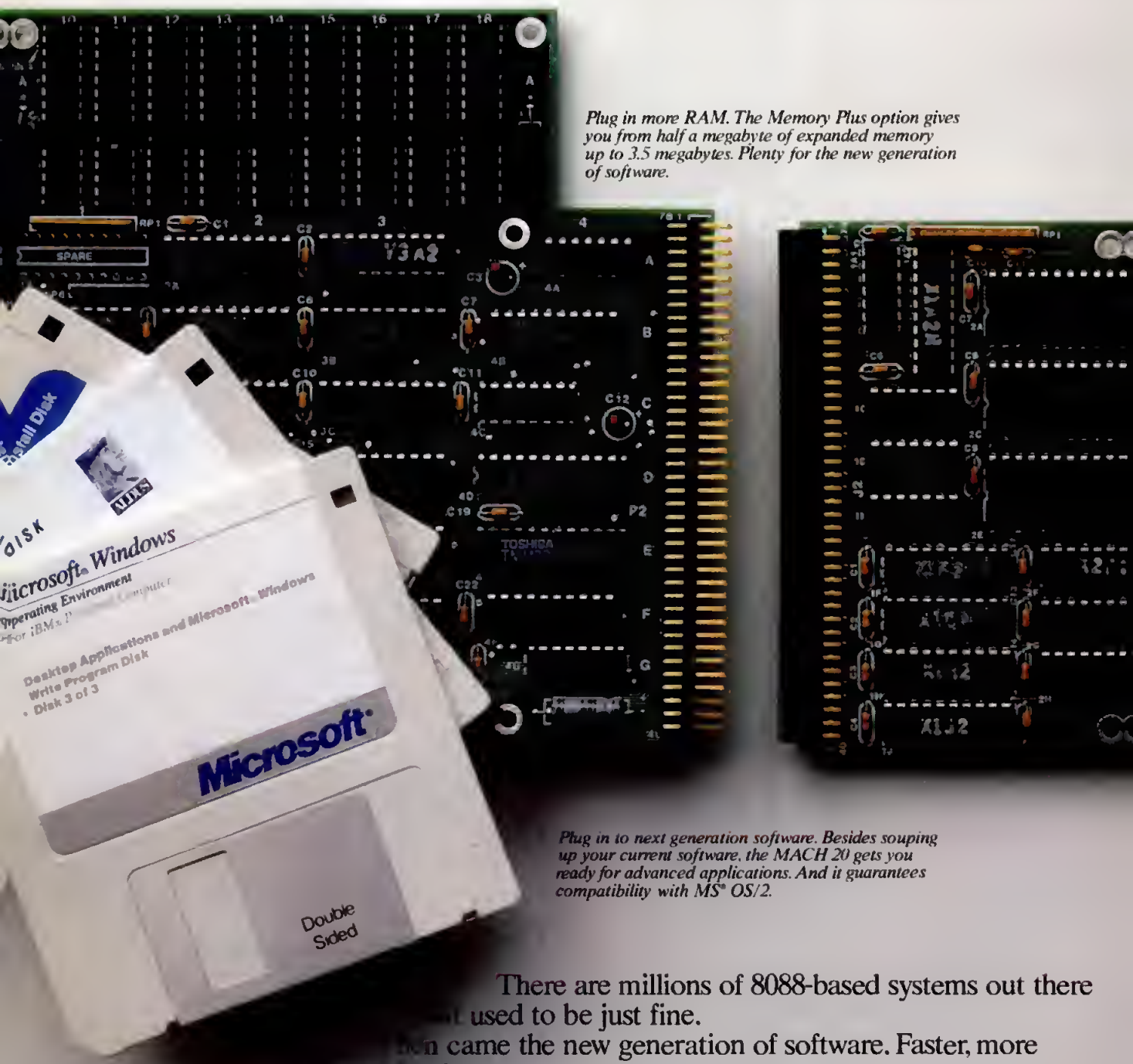
CIRCLE 239 ON READER SERVICE CARD

Microsoft just plugged



Plug in more RAM. The Memory Plus option gives you from half a megabyte of expanded memory up to 3.5 megabytes. Plenty for the new generation of software.

Plug in to next generation software. Besides souping up your current software, the MACH 20 gets you ready for advanced applications. And it guarantees compatibility with MS® OS/2.

There are millions of 8088-based systems out there used to be just fine.

came the new generation of software. Faster, more powerful software.

Software that needed more powerful hardware, with more memory, and more processing speed.

Suddenly, those 8088's weren't so fine.

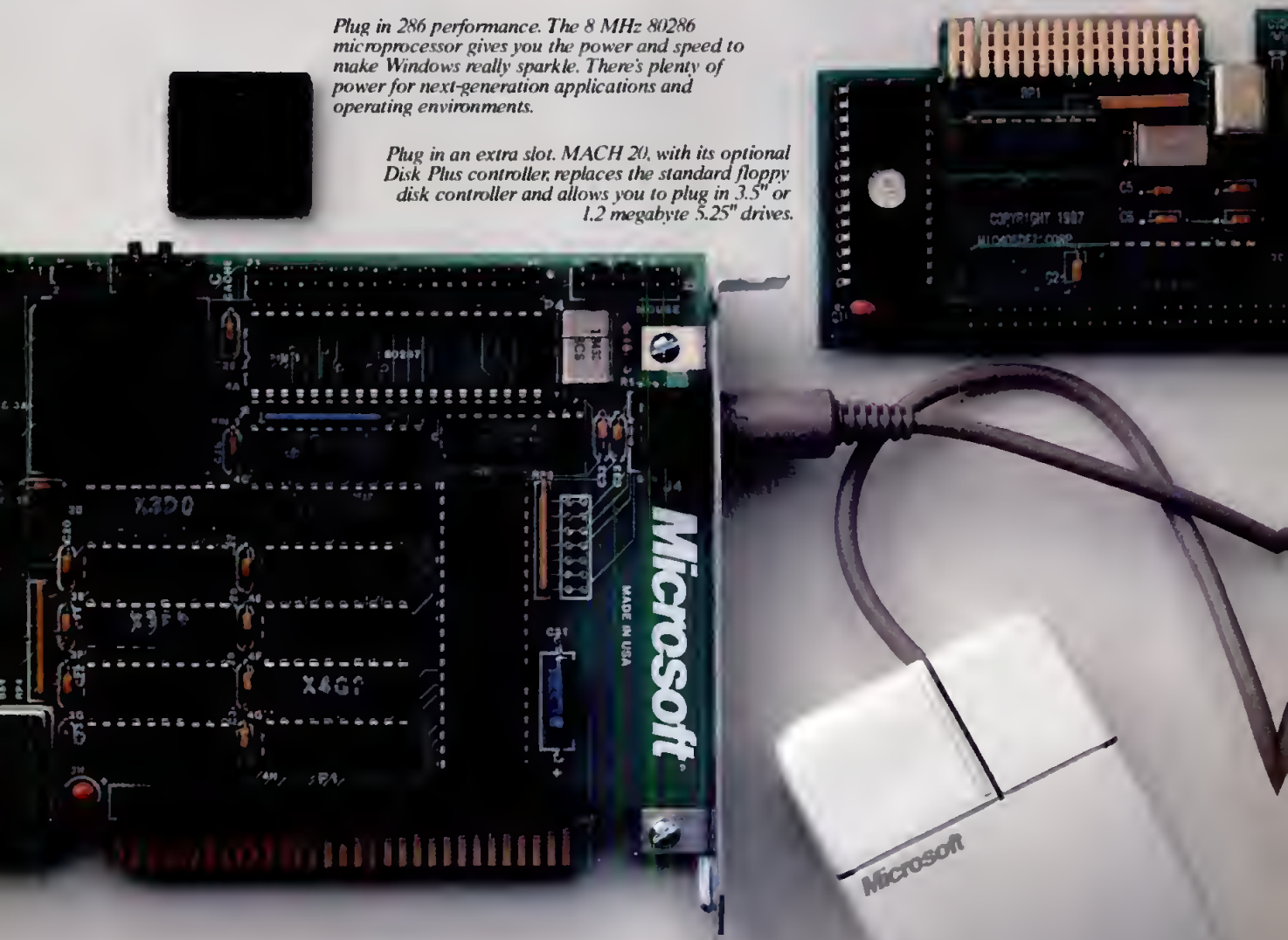
But happily, from the makers of a lot of that new software comes

*MACH 20 Memory Plus, Disk Plus and Microsoft Mouse are optional. Contact Microsoft for a list of internal disk drives that are compatible with MACH 20 Disk Plus.

the generation gap.

Plug in 286 performance. The 8 MHz 80286 microprocessor gives you the power and speed to make Windows really sparkle. There's plenty of power for next-generation applications and operating environments.

Plug in an extra slot. MACH 20, with its optional Disk Plus controller, replaces the standard floppy disk controller and allows you to plug in 3.5" or 1.2 megabyte 5.25" drives.



Plug in Microsoft Mouse. Invaluable for Windows and virtually all next-generation applications. The built-in InPort™ for a mouse saves your slot or a serial port for other things.

the MACH 20™ Performance Enhancement System.*

Plug it into any PC or XT, and you've instantly jumped to the next generation.

Not only is performance dramatically improved with software like Microsoft® Windows, PageMaker,® and other advanced applications, your machine will also be compatible with Microsoft Operating System/2.

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For the name of your nearest Microsoft dealer, call (800) 426-9400. In Washington State and Alaska, (206) 882-8088. In Canada, (416) 673-7638.
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KENSINGTON

*The Printer Mufflers are intended for use with dot-matrix printers only. They are not recommended for letter-quality printers, which run much hotter and require a cooling fan with enclosed

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CIRCLE 272 ON READER SERVICE CARD

Scan by Hand: A $249 20

HANDS ON

BY JARED TAYLOR

If the high price of scanners has been cramping your style, The Complete Hand Scanner, from The Complete PC, may be just what you need. This hand-held, 200-dot-per-inch device is likely to have a street price of just under $200, which should make it one of the cheapest digitizers around.

And it couldn't be easier to use. Load the accompanying software, press the little round button on the scanner, and drag it over the image you want to capture. You'll cover a strip 2½ inches wide and up to 10 inches long. This is plenty for symbols, logos, letterheads, and small halftones. You can adjust the scanner for brightness, like a Xerox machine, and you can also set its sensitivity to halftones.

The Complete Hand Scanner does very well with black-and-white line drawings. If you print a captured image on a laser printer, the output is only slightly fuzzier than the original. Halftones are more of a challenge, but you can get respectable results with differen scan text, bu ics, not ASCI

The scanne your computer i 4½- by 2-inch ca half-length slot. Y slot, but at least you kee serial ports.

The software that captures the images lets you crop them, rotate them, put them into reverse video, and resize them in discrete steps. The scanner also comes with a utility called Soft Stationery for overlaying images and combining them with text. However, it's neither very powerful nor easy to use, so you'll want some other program for fancy editing. Soft Stationery can convert images to *Dr. Halo*, *PC Paintbrush*, or *Windows* format, but it would be nice to have a TIFF (tagged image file format) option, too.

The Complete Hand Scanner's biggest drawback is its manual, which is surprisingly

The Complete Hand Scanner is a $249 hand-held graphics scanner that can masterfully scan black-and-white line drawings. Halftones pose more of a challenge to the scanner, but it can yield respectable results. Scanned text will end up in a graphics file, not an ASCII file.

The Complete Hand Scanner
The Complete PC
521 Cottonwood Dr.
Milpitas, CA 95035
(408) 434-0145
List Price: $249
Requires: 384K RAM; two disk drives (hard disk drive recommended); CGA, EGA, or Hercules card; DOS 2.1 or later.
In Short: A hand-held graphics scanner that connects to its own half-length card. At $249, it's one of the cheapest ways to input graphics.

CIRCLE 439 ON READER SERVICE CARD

dSalvage Resurrects Damaged .DBF Files

HANDS ON

BY MITT JONES

The Nartan Utilities and a crowd of similar file-recovery packages can counter the evil deeds of human imperfection—that unshakable prankster that deletes needed files and reformats data-packed disks before you can stop it. But, with the notable exception of the *Mace Utilities*, such packages offer little help when a few misbegotten bytes render your *dBASE* file unusable.

Enter Comtech Publishing's *dSalvage*, a $99.95 package designed to help you get damaged *dBASE* files back into action. *dSalvage* automates the diagnostic and recovery techniques outlined in the Comtech publication *Salvaging Damaged dBASE Files* (see First Looks, page 51, *PC Magazine*, July 21, 1987). It also adds a few new tricks and includes powerful *dBASE*-specific file editors for users well versed in *dBASE* file structure.

dBASE file problems can be as simple as misaligned records or as complex as a corrupted *dBASE* file header coupled with lost file clusters. *dSalvage* takes care of the simple problems automatically, requiring you to make only a few straightforward decisions. But the more complex problems require you to lend a helping hand.

For instance, when the automatic diagnosis reveals a corrupted header, you must supply a new header for the file. The program asks you to supply a database file that has an identical header. If you don't already have such a file, the program instructs you to exit the program and create one. If you don't remember enough about the database structure to re-create it, you can use the *dSalvage* header editor to patch the damaged header. The header editor isn't meant for the novice, however, and can be difficult to use if you're not familiar with *dBASE* file structure.

We tested *dSalvage* in a variety of situations, and for the most part the program earns its keep. In only one instance, a worst-case scenario involving a corrupt header and File Allocation Table errors, did the program not recover all or most of the records. And the program handled even this worst-case situation well on subsequent tries.

dSalvage compares favorably with dbFIX—the *dBASE* file-salvage program that is included with the *Mace Utilities*. Although dbFIX does prove easier to use, *dSalvage* sports several features that dbFIX does not, such as header and record editors and also the ability to unzap *dBASE* files.

If your copy of the *Mace Utilities* includes dbFIX, hang on to it: you'll prefer it over *dSalvage* for some uses. But *dSalvage* offers a unique and powerful range of tools for salvaging *dBASE* files.

FACT FILE

dSalvage
Comtech Publishing Ltd.
P.O. Box 456
Pittsford, NY 14534
(716) 586-3365
List Price: $99.95
Requires: 256K RAM, DOS 2.0 or later.
In Short: A well-rounded package that salvages damaged *dBASE* files. Not copy protected.

CIRCLE 444 ON READER SERVICE CARD

Photograph: Thom O'Connor

...emart

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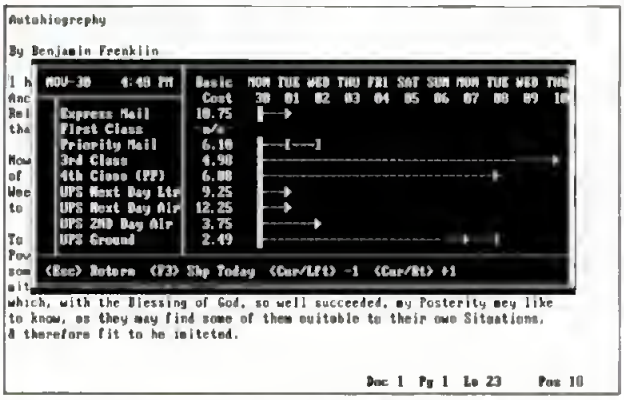
QUICK LOOKS

Keeping Postal and UPS Rates on Call

HANDS ON

BY EDWARD MENDELSON

Pony Express calculates the quickest and cheapest way to send letters and parcels via the U.S. Mail or United Parcel Service. Enter the ZIP code of the destination and the weight and value of your parcel, press a function key or two if you want options such as insurance or certified delivery, and Melisco Marketing's $79.95 utility displays rates for all available postal and UPS services. Press another function key for a graphic display of the estimated time of arrival for each service. It's up to you to choose between the tradeoff of cost and speed.



Pony Express *displays both rates and estimated arrival times, enabling you to choose among parcel services that are fast and costly or slow and cheap.*

Pony Express can run as a standalone program or as a TSR that fills as little as 9K RAM if it swaps its data to expanded memory or a disk. If run as an ordinary TSR, it fills 133K.

Many discount suppliers offer cheaper programs for calculating UPS rates, but *Pony Express* includes postal fees, estimated time of arrival, and a pop-up function that you won't find elsewhere.

What happens when rates go up? Depending on the complexity of the change, Melisco Marketing promises an upgrade for around $20 to $30. What happens when rates go down? Melisco has no contingency plan for that one.

List Price: *Pony Express*, $79.95.
Requires: 256K RAM, DOS 2.0 or later. Not copy protected.
Melisco Marketing Inc., 9719 Ensley Ln., Leawood, KS 66206; (913) 642-5005.

CIRCLE **449** ON READER SERVICE CARD

DOS, the Epic: An Educational Video

HANDS ON

BY ROBERT BARNETT

Though it runs longer than an epic movie, *DOS for Hard and Floppy Disk Users: Beginning Through Advanced Skills*, a videotape tutorial, is more interesting to watch than its 5-hour running time might suggest.

Produced by Learn-PC Video Systems, the videotape unscrambles the functions of DOS into an 11-lesson format. Like the company's *dBASE III Plus* tutorial, the DOS tutorial is designed for viewers with no PC experience.

The videotape starts with booting in the first lesson and, in subsequent lessons, explains command parameters, copying disks and files, printing and viewing files, organizing subdirectories, pipe commands, data protection, EDLIN, and batch files. The presentation drags at times but is always very clear, with verbal explanations complemented by demonstrations and instruction screens.

The beauty of this tutorial is that it offers something for anyone who is not a DOS expert. PC novices have a complete course at their fingertips. The seasoned PC user who thinks of DOS only as a prompt need only skip the first lesson before gleaning useful information. And those who are well acquainted with DOS file management capabilities may find the EDLIN and batch file instruction worthy of their time.

List Price: *DOS for Hard and Floppy Disk Users: Beginning Through Advanced Skills*, $895.
Requires: VHS or Betamax player, two blank floppy disks, DOS 2.0 or later. Learn-PC Video Systems, 1525 Glenwood Ave., Minneapolis, MN 55405; (800) 532-7672, (612) 377-2222.

CIRCLE **451** ON READER SERVICE CARD

Popping Addresses onto Your Envelopes

HANDS ON

BY JONATHAN MATZKIN

There is something unsatisfying about printing out a great-looking letter, then stuffing it into an envelope suffering from a sample of your poor penmanship. It's like hiding a Ferrari engine under an Edsel body.

Addresselope, a $35.95 pop-up created by Barry A. Watzman, ushers the humble envelope into the modern era by bringing it into your laser printer (the program also works with ASCII impact printers that accept envelopes). This utility lets you type addresses and store them in a series of buffers, keeping them there until you are ready to print them out on your envelopes.

You can also capture the appropriate addresses by popping *Addresselope* up over the inside address of an on-screen letter, marking the address as a block, and importing it into the buffer.

Addresselope is configured to print on up to four different sizes of envelopes. The program is preformatted for #10 and #6¼ envelopes; there are also two user-definable formats.

Like many TSR programs, *Addresselope* has its quirks. It locks up *XyWrite* completely, and the documentation carefully informs the user that the program must be the last TSR loaded if it is to be later removed from memory.

I got excellent results with *Addresselope* and my LaserJet. There is no doubt that crisp, laser-printed characters look a lot better than the handwriting that routinely earned me D's in penmanship.

List Price: *Addresselope*, $35.95.
Requires: Hewlett-Packard LaserJet, LaserJet Series II, or compatible, or ASCII impact printer designed to accept envelopes. Not copy protected.
Barry A. Watzman, 560 Sunset Rd., Benton Harbor, MI 49022; (616) 925-3136.

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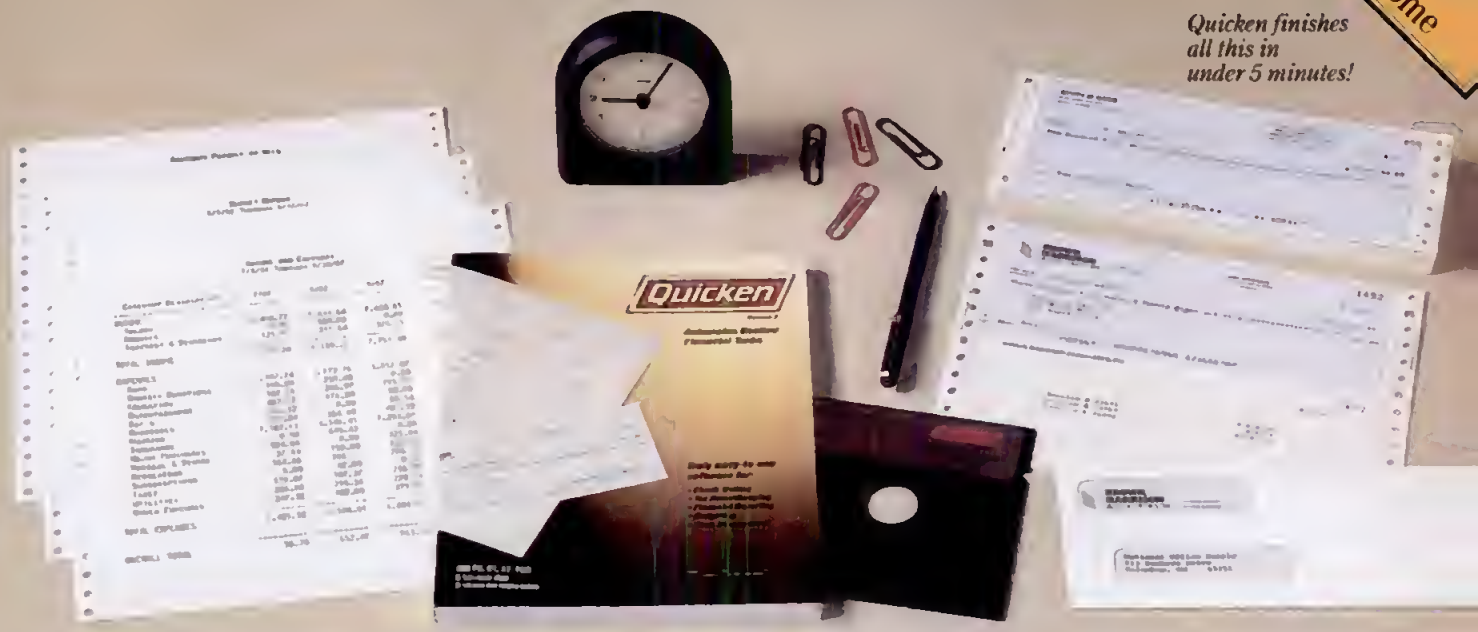

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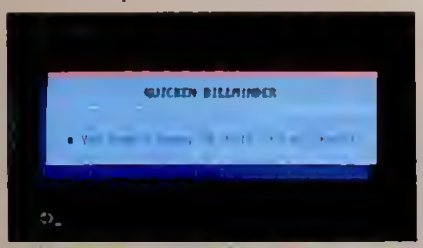

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Software Compatibility: Exports data and reports in ASCII. Also exports in Lotus® format with optional Transfer Utility
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Capacity: Number of bank accounts: unlimited. Number of transactions: unlimited. Maximum amounts: $9,999,999.99. Number of income/expense categories: 250 with 256K, thousands with 512K RAM
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CIRCLE 151 ON READER SERVICE CARD

PipeNet Connects up to 50 PCs With Remote Access and E-Mail

HANDS ON

BY FRANK J. DERFLER, JR. AND ERIC COLE

Purvis Systems' PipeNet is based on the idea that by combining PCs, you can perform operations that would otherwise require an expensive mainframe. PipeNet is a menu-driven electronic communications system using modems and standard telephone lines to link up to 50 PC workstations using a single dedicated PC AT as a host.

Because they use dial-in phone lines, PipeNet workstations can be across the hall or across the ocean from the server. The PipeNet software allows network members not only to exchange messages and files automatically, but also to send DOS .BAT files to other computers in the network and have those commands execute automatically when they come in.

Purvis Systems terms this ability to send DOS commands "process transfer." It is the next step up from the file transfer we usually perform with modems and communications programs. If a task like updating a few records and causing a DBMS program to reindex the database is initiated remotely, you avoid transferring a large file. Initiating printouts on a machine calling in to the PipeNet host is a substitute for fax transmission. People in the field don't need training on complex applications if the operations are initiated remotely.

The person running the calling station can view and approve any processes before execution. Warning—a FORMAT C: command received from the boss could be regarded as the equivalent of having your office furniture put out in the hall!

Designed for the novice, the PipeNet software running on the calling station is built around a main menu giving access to all functions, backed by a help option. The main menu tells you if there is any mail or if processes are waiting for you. Sending a message or file involves hitting a function key to enter the correct addressing information, entering your password, using the built-in editor to prepare the message, and storing it for transmission to the host during the next dial-in session.

Any multiuser system such as PipeNet needs tight control, and the developers insist on the appointment of a System Administrator (SA) to take charge of network organization and security. The SA needs no special microcomputer knowledge but must know the application software and hardware configuration of PCs calling into the host. Along with duties such as being the key contact for program updates and passwords, the SA is responsible for the preparation and distribution of PipeNet "personality disks." These customized disks give each authorized user identification and mail privacy.

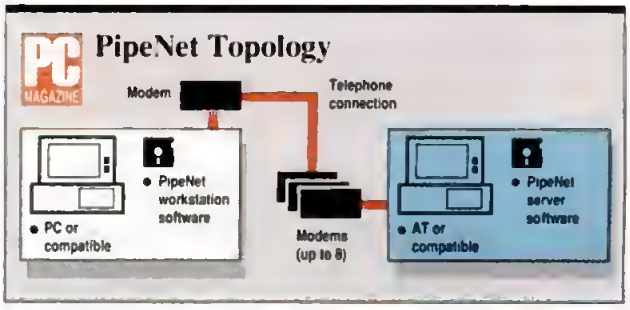
PipeNet software runs on any IBM PC or clone with at least 384K RAM and a Hayes-compatible modem. A dedicated IBM PC AT with 1MB RAM is required for the host, with a hard disk to contain the PipeNet-installed UNIX system and message banks. In addition, Purvis Systems offers a multiport RS-232C adapter that allows eight modems to connect to the host simultaneously.

The electronic mail system in PipeNet is excellent. A full-screen editor gives good flexibility, and messages are easy to forward and answer. The one omission we noticed was automatic dial-out by the host. All remote users must dial into the host; the host doesn't initiate any outgoing connections.

The main drawbacks to any system using dialed telephone lines as PipeNet does are the constraints put on the speed and quality of data transmission. The software contains extensive error-checking capabilities, and the ability to send commands to initiate local processing reduces the need to send data.

PipeNet is an excellent electronic mail system for widespread organizations. It is also a distributed processing network with unique features. PipeNet has a lot to offer an organization firm that wants to link up and better utilize a far-flung empire of PCs.

This PipeNet menu greets every user. In this case, no messages are waiting in the read queue (F4), but messages are ready to go out to the server (F9). Incoming processes are allowed to operate automatically (F8), and this user is authorized to prepare processes for transmission to other stations (F7) through the PipeNet server.



PipeNet's UNIX-based software can extend e-mail and process control to up to 50 stations, through dial-up lines. The server can manage up to eight modems.

FACT FILE

PipeNet, Version 2.1
Purvis Systems Inc.
4715 Viewridge Ave.
San Diego, CA 92123
(619) 560-7400
Requires: Host: IBM PC AT with 1MB RAM, 30MB hard disk drive. Terminals: 384K RAM, one disk drive, Hayes-compatible modem.
List Price: Host system (includes optional host IBM PC AT compatible and 30MB disk), $6,647; workstation license, from $350 per station (51 or more) to $700 (1 to 5).
In Short: A relatively inexpensive way to provide an electronic mail and file server and automatically combine PCs to execute DOS commands. Although PipeNet is an excellent mail delivery system for far-flung users, its main advantage is the ability to transfer DOS commands to computers in the network and have them execute automatically.

CIRCLE 440 ON READER SERVICE CARD

Only new Cubit™ squeezes more than 1-2-3® files.

It's the fastest, easiest, least costly way to free more disk space for all your files.

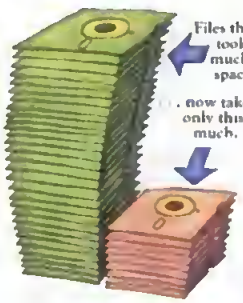
You know what happens. Files just keep piling up on your hard disk, until one day, there's no room left.

But before you buy a bigger hard drive, or the other well-known compression software, consider this – only Cubit maximizes disk space by efficiently compressing 1-2-3 worksheet files, plus *all* your other files.

What is Cubit?

Cubit is an advanced software tool that reduces the number of bytes required to store a file on disk – either all your files, or if you want, just some of them. In memory-resident mode, it works invisibly in the background, automatically converting files back to their original size when retrieved, and re-compressing when you save them again.

The result is a dramatic increase in the amount of data you can fit on all your magnetic media – including hard drives, floppies and tapes. All without complicated commands, or interrupting your work-flow.



Cubit compresses all kinds of files up to 70%—so hard disks and floppies store more than twice as much data as before.

Now Cubit's optimized for 1-2-3.

Cubit has always performed superbly with all kinds of data – particularly text files and databases.

But now, Cubit is the most effective software you can buy for compressing your Lotus worksheets. In fact, new Cubit gives you an average of 70% compression for both 1-2-3 and Symphony files.

And remember, we said *average* compression, which takes into account all your Cubit-compressed worksheets.

The other compression software maker promises 95% – but doesn't tell you that it's only in extreme cases. That your average results will be less, usually a lot less. What's more, their program works with 1-2-3 files only, and nothing else.

Yet new Cubit gives you optimum results with all your files, from all your programs. Including word processors (54% average), database managers (40% average), accounting packages (40% average), graphics files (26% average), everyrhing you keep on your disks.

It's the biggest idea in small files yet.

Cubit not only works better than the other compression software, it works faster. For example, Cubit decompresses files in 1-2-3 twice as fast as the other program. So your spreadsheet is up on screen in half the time.

That same "other" program re-compresses 1-2-3 files each time you save them. Cubit waits until you exit 1-2-3, and then automatically re-compresses all the compressed files that were used during that session. Imagine the time you'll save.

Plus, only Cubit includes UnCubit,™ a special decompress-only program you can distribute freely, so you can share your Cubit-compressed files. It's ideal for team projects. And great for saving line charges on tele-communicated files. Just send UnCubit along with your transmission.

So why buy a bigger drive, when you can have smaller files?

Cubit is already saving time and trouble for thousands of PC users. All for a fraction of the cost and bother of a bigger hard drive. And a lot less than you'd pay for the other compression program.

Look for Cubit at software dealers everywhere. Or order direct from SoftLogic Solutions by calling us toll-free. If, within 30 days, you're not satisfied that Cubit is the fastest, easiest, smartest way to free up disk storage space, we'll gladly arrange for a refund of your purchase price.

Here's what people are saying about Cubit.

"1-2-3 users will love it. . ."
– David Trivette, PC World, October 1987

"Saved me $700 for a new disk drive. This product is everything you said it was."
– David Silver, Trio Services, Thornhill, Ontario

"I gained almost 4MB of storage."
– Dennis Garoutte, Impact Management, Inc., Branson, MO

"Well conceived product, good documentation, good price, works well – I am indebted!"
– Tom Mayhew, Cogent Data Services, Inc., Lilburn, GA

"It's an excellent utility. We've compressed our files 40-50%!!"
– Edward Moy, Humana Medfirst, Bridgton, MO

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CIRCLE 288 ON READER SERVICE CARD

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All in all, it's the perfect way to go to work without going to work. Or to get home early, even when you'll be working late.

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Seagate	MK-ST225	20MB, 85ms, ½ ht., 5.25", w/WD controller	$239	$217
Miniscribe	MB-5425	20MB, 85ms, ½ ht., 5.25", w/WD controller	$287	$211
Miniscribe	MK-3425+	20MB, 53ms, ½ ht., 5.25", w/WD controller. .	$296	$257
Seagate	MK-ST238	30MB, 55ms, ½ ht., 5.25", w/Adaptec cont.	$288	$257
Seagate	MK-ST238	30MB, 65ms, ½ ht., 5.25", w/WG controller	$284	$257
Miniscribe	MK-3438	30MB, 65ms, ½ ht., 5.25", w/Adaptec cont.	$280	$243
Miniscribe	MK-3438	30MB, 65ms, ½ ht., 5.25", w/WD controller	$288	$243
Miniscribe	MK-3438+	30MB, 53ms, ½ ht., 5.25", w/Adaptec cont.	$330	$296
Miniscribe	MK-3458+	30MB, 53ms, ½ ht., 5.25", w/WG controllsr	$333	$296
Seagate	MK-4058	30MB, 40ms, full ht., 5.25", w/WD controllsr	$548	$495
Miniscribe	MK-5650	40MB, 58ms, ½ ht., 5.25", w/WD controller	$396	$352
Seagate	ST-251	40MB, 40ms, full ht., 5.25", w/WD controller .	$439	$393
Miniscribe	MK-6085	70MB, 28ms, full ht., 5.25", w/WD controller	$843	$792
Seagate	MK-4096	80MB, 28ms, full ht., 5.25", w/WD controller	$944	$891

**XT kits include drive, controller, bezel, 20/34 pin cable, mounting hardware and manual*

AT DRIVE KITS

			KIT	BARE
Seagate	MK-ST4058AT	30MB, 40ms, full ht., 5.25"	$498	$495
Miniscribe	MK-5650AT	40MB, 88ms, ½ ht., 5.25" .	$337	$352
Seagate	MK-ST251AT	40MB, 40ms, ½ ht., 5.25"...	$398	$393
Seagate	MK-ST251K AT	40MB, 40ms, ½ ht., 5.25"...	$446	$441
Seagate	MK-ST251-1 AT	40MB, 28ms, ½ ht., 5.25"	$338	$553
Miniscribe	MK-6055AT	40MB, 28ms, full ht., 5.25"	$398	$594
Seagate	MK-4055AT	40MB, 28ms, full ht., 5.25"	$398	$584
Seagate	MK-ST277K AT	55MB, 40ms, ½ ht., 5.25"	$998	$691
Miniscribe	MK-6085AT	70MB, 28ms, full ht., 5.25"	$797	$792
CDC	MK-CDC-94155086	70MB, 28ms, full ht., 5.25"	$788	$783
Seagate	MK-ST4096AT	80MB, 28ms, full ht., 5.25"	$898	$891
Miniscribe	MK-6128AT	110MB, 28ms, full ht., 5.25" . . .	$992	$987

**AT kits include drive, 20 pin cable, mounting rails, software where applicable and manual.*

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Thomson	Ultrascan	13", EGA/CGA/MDA/HERC comp., 800x500 res.	$319
NEC	Multisync Plus	15", EGA/ENH-EGA/PGC/MCGA/VGA, 950x720 res.	$897
NEC	Multisync XL	20", EGA/ENH-EGA/PGC/MCGA/VGA, 1024x758 res.	$2298

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Mountain	TP-MOU-5720-01	40MB, ext., ½ ht., w/tape for XT/AT	$497
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Archive	TP-ARC-2067905	60MB, ext., ½ ht., w/tape for AT	$598
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Western Digital	WC-WD1003-SR4	2,7 RLL encoded for AT	$145
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Taac	FD-TEA-55KV	360K, ½ ht., 5.25", *black for XT*	$ 81	Panasonic	FD-PKN-JU455AT	360K, ½ ht., 5.25", *grey for AT*	$ 98
Taac	FD-TEK-55B-KT	360K, ½ ht., 5.25", *grey for AT*	$ 88	Fujitsu	FD-FUJ-2552A18	720K, slimline, 3.50", *black for AT* .	$ 84
Taac	FD-TEA-55FN2S	720K, ½ ht., 3.50", *black for AT*	$107	Fujitsu	FD-FUJ-2555K05	1.2M, ½ ht., 5.25", *grey for AT*	$ 88
Panasonic	FD-PKN-JU475AT	1.2M, ½ ht., 5.25", *grey for AT*	$114	Taac	FD-TEK-55FCVRT	1.2M, ½ ht., 5.25", *grey for AT*	$109

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Genoa	BV-GEN-4850-5	*EGA/CGA/MDA/HERC comp., 800x600 res.*	$299	Genoa	BV-VIO-VEGA-VG	*VGA/EGA/CGA/MDA/HERC comp., 800x600 res.*	$309

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CIRCLE 229 ON READER SERVICE CARD

NEW ON THE MARKET

Math Works Introduces the First Software Package for Weitek Numeric Coprocessor

The Math Works has introduced *386/Weitek-Matlab* for the Compaq Deskpro 386/20 or compatibles equipped with the Weitek 1167 coprocessor. *Matlab* provides numerical analysis, matrix computation, signal processing, and graphics in a single environment. The company has also introduced *386-Matlab*, a version of the software for 80386 PCs running the 80387 or 80287 coprocessor.

The Math Works says that *386-Matlab*, with the 80387, generates performance that's ten times as fast as a standard AT. The Weitek chip boosts performance an additional 200 percent, the company says.

The *Matlab* packages are interactive and incorporate as their basic data object a matrix that requires no dimensioning. *Matlab*'s matrix interpreter accepts commands in standard mathematical notation.

List Price: *386/Weitek-Matlab*, $1,995. *386-Matlab*, $1,495. **Requires:** 1MB RAM; 80386-based PC with 80287 or 80387 coprocessor (for *386/Weitek-Matlab*, a Weitek 1167 coprocessor); EGA, CGA, or Hercules graphics adapter; DOS 3.1 or later. Not copy protected. The Math Works Inc., 20 N. Main St., #250, Sherborn, MA 01770; (617) 653-1415.

CIRCLE **432** ON READER SERVICE CARD

The EM-1000

Mono PAD, from Emucom, is a low-cost ($325) way to add X.25 protocol access to any 1,200- or 2,400-bit-per-second, AT-compatible, synchronous-capable modem.

Modem Add-on Gives Users Easy, Low-Cost X.25 Protocol Access

The $325 EM-1000 Mono Packet Assembler/Disassembler (PAD), from **Emucom**, converts any 1,200- or 2,400-bit-per-second, AT-compatible, synchronous-capable modem to an X.25/X.32 PAD that is transparent to the user. The EM-1000 provides low-cost X.25 user-access capabilities and end-to-end error correction. Emucom says the product is suitable for access to major public packet-switching networks such as Telenet.

The company also offers the $795 EM-2400, which combines the functionality of the EM-1000 with a synchronous/asynchronous modem that meets Bell 103 and 212A specifications.

List Price: EM-1000, $325. **Requires:** Synchronous-capable modem.

List Price: EM-2400, $795 (internal version, $745). Emucom Inc., 25 Industrial Ave., Chelmsford, MA 01824; (617) 256-9871.

CIRCLE **436** ON READER SERVICE CARD

UniSaver Standalone System Protects RAM Data from Power Loss

A new subsystem from **Universal Vectors Corp.** is said to combine three important functions for data security. The $1,399 UniSaver has 1MB of battery-backed-up RAM and preserves the exact state of the PC in the event of a power interruption. It also works as an uninterruptible power supply that lets you power-down safely if the lights go off.

Universal Vectors says that UniSaver puts your system into "hibernation" in the event of a power failure. All RAM data is preserved in battery-backed-up memory, and you can resume

New Communications Boards Connect IBM PS/2 Machines to Mainframe Computers

IBM's vision of the Micro Channel as part of an overall computing environment continues to take shape. Third-party manufacturers are introducing add-in cards that connect the new-bus micros to larger systems.

IDEAssociates has introduced the $1,295 IDEAcomm 3278/DFT, a local coax PC-to-mainframe communications board, and the $895 IDEAcomm 3270/SNA, which provides remote communications via asynchronous modem. Both products are available for the PS/2 Models 50, 60, and 80, in addition to the traditional PC. The IDEAcomm 3278 board and accompanying software accommodate as many as five host sessions, two of which can be printer emulation. The 3270/SNA board allows remote users to run up to eight host sessions, which may be used for display and printer emulation.

Both products have terminal emulation for IBM 3278 Models 2, 3, 4, 5, and 3179, and both allow PC printers to emulate the IBM 3287 system printer. A hotkey lets you toggle between the mainframe and the PC without logging off the mainframe.

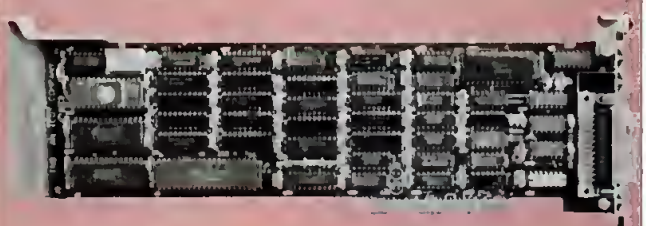
Meanwhile, **INS Corp.** has introduced its own Micro Channel–to-mainframe boards. The company's SDLC and X.25 adapters ($995 each) connect Model 50s, 60s, and 80s to SNA mainframes by emulating a 3274 Model 51C cluster controller. SDLC connection is via switched or leased line or multipoint operation, while X.25 connection is by switched or leased line over public or private networks. The boards are microprocessor based and run at speeds of up to 19,200 bits per second. They support multiple concurrent sessions, as well as hotkey session switching.

List Price: IDEAcomm 3278/DFT, $1,295; IDEAcomm 3270/SNA, $895. **Requires:** 128K RAM, DOS 2.0 or later. IDEAssociates Inc., 29 Dunham Rd., Billerica, MA 01821; (617) 663-6878.

CIRCLE **433** ON READER SERVICE CARD

List Price: INS SDLC and X.25 adapters, $995 each. **Requires:** 128K RAM; PS/2 Model 50, 60, or 80; DOS 3.3. INS Corp., P.O. Box 91395, Mobile, AL 36691; (800) SNA-3270.

CIRCLE **434** ON READER SERVICE CARD



INS offers the SDLC adapter ($995) that connects Micro Channel PS/2s to mainframe systems. The board supports multiple concurrent host sessions.

by Jonathan Matzkin

operation from the exact point of interruption when the power comes back on. All files will be open, and all TSRs will be available just as before the power loss. Battery backup preserves data for days, rather than hours, according to Universal Vectors. As with traditional UPS systems, UniSaver will run your system on battery power in the event of AC failure. An AT, monitor, and printer will run for up to 20 minutes.

With UniSaver's "placemark" feature, you can place work in progress under a keylock. Others can use your system but are denied access to work you have keylocked.

List Price: UniSaver, $1,399.
Requires: Full-length PC-compatible expansion slot.
Universal Vectors Corp., 1875 Connecticut Ave. NW, #1110, Washington, DC 20009; (209) 234-6547.

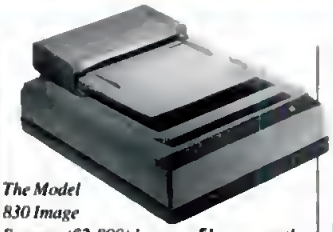
CIRCLE **435** ON READER SERVICE CARD

Datacopy Scanner and Utility Format Tabular Text into Spreadsheets

The $2,800 Model 830 Image Scanner, from **Datacopy**, is one of three high-performance scanners introduced by the company. The Model 830 has a maximum resolution of 300 by 600 dots per inch. It can work with *OCR 4mat*, a $195 utility that takes scanned text files and formats them into a *1-2-3* worksheet. The data is automatically formatted in the worksheet, and the software works with any scanner that sends ASCII files, according to Datacopy.

The program takes already-scanned text files, extracts tabular data, and then formats the data into a .WKS file for *1-2-3*. Datacopy says that *OCR 4mat* recognizes cell formulas as well as labels. It places both formulas and labels in their proper places in a spreadsheet.

List Price: Model 830 Image Scanner, $2,800.
List Price: *OCR 4mat*, $195.



The Model 830 Image Scanner ($2,800) is among three recently introduced high-resolution scanners from Datacopy.

Requires: 640K RAM, 10MB hard disk drive, scanner, DOS 2.1 or later. Not copy protected.
Datacopy, 1215 Terra Bella Ave, Mountain View, CA, 94043; (415) 965-7900.

CIRCLE **438** ON READER SERVICE CARD

Suspended Computing Is Made Possible with Spring-Loaded Bracket

Ergotron has introduced a workstation that lets you reclaim some of the desk space that vanished when you entered the PC computing world. The Ergotron Engineering Workstation suspends your monitor and CPU over a flat work surface, so you have room to work without sacrificing convenience.

A gas-spring-powered arm holds your monitor and provides adjustment motion of 6 inches vertically and 24 inches horizontally. The arm also pivots 180 degrees. The monitor can be tilted up to 20 degrees and swiveled 360 degrees. The arm will support a monitor that weighs up to 80 pounds. Your CPU sits on an overhead shelf.

List Price: Ergotron Engineering Workstation, $499.95. Ergotron Inc., 1621 E. 79th St., Minneapolis, MN 55420; (612) 854-9116.

CIRCLE **437** ON READER SERVICE CARD

The $499.95 Ergotron Engineering Workstation suspends your monitor and CPU over a flat work surface.

HOT PROSPECT

WordPerfect's Approach to Data Management: Programming, Menus

WordPerfect Corp. is throwing its weight into the programmable relational database world currently dominated by *dBASE III Plus*. *DataPerfect* combines a declarative programming language with a menu-driven definition scheme to provide both power and ease of use, according to WordPerfect.

In keeping with the company's tight integration among its products, *DataPerfect* is compatible with both the company's top-selling word processor and *WordPerfect Library*. Records can be imported in either delimited DOS text or *WordPerfect* merge format. Functions can be called by a series of Ctrl-, Shift-, and Alt-function key combinations.

DataPerfect supports one-to-many, one-to-one, many-to-one, and many-to-many data relationships.

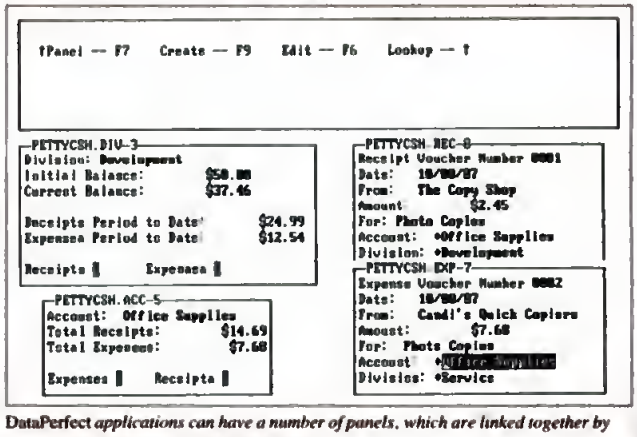
DataPerfect is also said to have extremely flexible report-writing capabilities. Reports can be viewed on-screen, sent to a printer, saved as a disk file, or appended to an existing file. A "subreports" feature combines information from two or more linked files for use in the same report.

Indexes can be created with any single field or several fields in a database. If more than one field is selected for an index, the fields are concatenated to form a sort list that the index will use to sort records. Several indexes per database can be defined, thus allowing records to be cross-referenced in many different ways.

When running on a network, *DataPerfect* allows up to 99 users to access a subdirectory or database at once.

List Price: *DataPerfect*, $595; $495 for five additional network stations. **Requires:** 192K RAM, two disk drives, DOS 2.1 or later (DOS 3.0 required for network use). Not copy protected.
WordPerfect Corp., 288 W. Center St., Orem, UT 84057; (801) 225-5000.

CIRCLE **431** ON READER SERVICE CARD



DataPerfect applications can have a number of panels, which are linked together by "doorways" attached to a particular field.

PC UPDATE

edited by Peggy Gavan

Compaq Video Graphics Color and Monochrome Monitors, Controller Board, Expanded Memory Board

Compaq Computer Corp.'s three new VGA display products—the **Video Graphics Color Monitor**, **Video Graphics Monochrome Monitor**, and **Video Graphics Controller Board**—provide enhanced resolution and high-performance graphics for the company's line of Deskpro and Portable computers. The

Compaq Computer's new Video Graphics Monochrome Monitor ($225) offers high performance graphics for the company's Deskpro and Portable computers.

Controller Board, which is priced at $599, allows users to run applications up to 50 percent faster than the IBM PS/2 VGA and is completely compatible with both the 8-bit and 16-bit standard data bus. Both the color and the monochrome monitors, priced at $699 and $255, respectively, can display a graphics resolution of 640 by 480 and a text resolution of 720 by 400 when they are used with the controller board. In addition, Compaq has added an internal 12-MHz **Expanded Memory Board** option to the Portable III that allows users to access expanded memory when working with applications that support LIM EMS, Version 3.20. The memory add-in board has a list price of $299. Compaq Computer Corp., Houston, Tex.; (713) 370-0670.

Energraphics, Version 2.2

Energraphics, Version 2.2, allows users to integrate their drawings and charts—and it supports both *PC PageMaker* and *Ventura Publisher*. The new version, which is available to registered users for $49, also includes ASCII import, batch file processing, and a slide presentation feature. Additionally, Enertronics Research has announced ***Kaleido-View***, a series of add-on programs for *Energraphics* that generate all visuals in three-dimensional perspective, isometric view, or oblique view. The first two products in this series, *Kaleido-Chart* and *Kaleido-Map*, are priced at $99 each. Enertronics Research Inc., St. Louis, Mo.; (314) 421-2771.

Symphony, Version 2.0

With Version 2.0, Lotus Development Corp. has removed copy protection from ***Symphony*** and added enhancements to all the modules in the integrated software package. Among the new features are automatic paragraph reformatting, improved spreadsheet recalculation, form field editing, and VT-100 terminal emulation. The new version also includes an add-in 80,000-word spelling checker and an add-in text outliner. *Symphony*, Version 2.0, is priced at $695. Upgrades are approximately $100 for registered users of Version 1.2. Lotus Development Corp., Cambridge, Mass.; (617) 577-8500.

IN BRIEF

Baler, Version 3.3, fully supports *Lotus 1-2-3* graphics, macros, and @functions. *Baler* is priced at $495; upgrades are free to registered users who purchased the program after October 1, and $50 for all other users. Brubaker Software, Lafayette, Ind.; (317) 564-2584 . . . ***3-D Graphics***, Version 1.01, has several minor enhancements and a new $95 price tag, an increase of $15. Intex Solutions Inc., Wellesley, Mass.; (617) 431-1063.

PS/2 WATCH

PC Mouse, PS/2 Version

MSC Technologies has added the **PC Mouse, PS/2 Version**, to its line of optical mice. The new model, which plugs into a PS/2 mouse port, includes Designer Pop-up menus and

The PC Mouse, PS/2 Version, includes new Mouse Systems drivers that support all IBM VGA graphic modes.

drivers that support all the IBM VGA graphic modes. The new PC Mouse has a retail price of $159. MSC Technologies, Santa Clara, Calif.; (408) 988-0211.

Program in the fast lane with Borland's new Turbo Pascal 4.0!

Our new Turbo Pascal* 4.0 is so fast, it's almost reckless. How fast? Better than 27,000 lines of code per minute. That's more than twice as fast as 3.0 and the reason why you need 4.0 today.

4.0 breaks the code barrier

No more swapping code in and out to beat the 64K code barrier. Designed for large programs, Turbo Pascal 4.0 lets you use every byte of memory in your computer.

4.0 uses logical units for separate compilation

Pascal 4.0 lets you break up the code gang into "units," or "chunks." These logical modules can be worked with swiftly and separately. Compiling and linking these separate units happens in a flash because your compiling horsepower is better than 27,000 lines a minute.* And 4.0 also includes an automatic project Make.

4.0 Highlights:

- Compiles 27,000 lines per minute
- Includes automatic project Make
- Supports > 64K programs
- Uses units for separate compilation
- Integrated development environment
- Interactive error detection/location
- Includes a command-line version of the compiler

60-Day Money-back Guarantee**

*Run on an 8MHz IBM AT

**If within 60 days of purchase this product does not perform in accordance with our claims, call our customer service department, and we will arrange a refund.

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4.0's cursor automatically lands on any trouble spot

4.0's interactive error detection and location means that the cursor automatically lands where the error is. While you're compiling or running a program, you get an error message *and* the cursor flags the error's location for you.

4.0 gives you an integrated programming environment

4.0's integrated environment includes pull-down menus and a built-in editor. Your program output is automatically saved and shown in the output window. You can Scroll, Pan, or Page through all your output and know where everything is all the time. Given 4.0's integration, you can edit, compile, find and correct errors—all from inside the integrated development environment. We even include a command line version of the compiler.

Compatibility with Turbo Pascal 3.0

We've created Version 4.0 to be highly compatible with Version 3.0 and included a conversion program and compatibility units to help you convert 3.0 programs to 4.0.

4.0 is all yours for only $99.95

Sieve (25 iterations)

	Turbo Pascal 4.0	Turbo Pascal 3.0
Size of Executable File	2224 bytes	11682 bytes
Execution speed	9.3 seconds	9.7 seconds

Sieve of Eratosthenes, run on an 8MHz IBM AT

Since the source file above is too small to indicate a difference in compilation speed we compiled our CHESS program from Turbo Gameworks to give you a true sense of how much faster 4.0 really is!

Compilation of CHESS.PAS (5469 lines)

	Turbo Pascal 4.0	Turbo Pascal 3.0
Compilation speed	12.1 seconds	35.5 seconds
Lines per minute	27,119	9,243

CHESS.PAS compiled on an 8 MHz IBM AT

For the IBM PS/2* and the IBM* and Compaq* families of personal computers and all 100% compatibles

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Registered owners have been notified by mail. If you are a registered Turbo Pascal user and have not been notified of Version 4.0 by mail, please call us at (800) 543-7543. To upgrade if you have not registered your product, just send the original registration form from your manual and payment with this completed coupon to:

Pascal 4.0 Upgrade Dept.
Borland International
4585 Scotts Valley Drive
Scotts Valley, CA 95066

Name _____

Ship Address _____

City _____ State _____

Zip _____ Telephone ( ) _____

For the IBM PS/2* and the IBM* and Compaq* families of personal computers and all 100% compatibles.

This offer is limited to one upgrade per valid registered product. It is good until June 30, 1988. Not good with any other offer from Borland. Please allow 4 to 6 weeks for delivery of Toolboxes.

Outside U.S. make payments by bank draft payable in U.S. dollars drawn on a U.S. bank. CODs and purchase orders will not be accepted by Borland.

Please check box(es)	Suggested Retail	Upgrade†	Serial No.
☐ Turbo Pascal 4.0 Compiler	$ 99.95	$ 39.95	_____
☐ Turbo Pascal Tutor	59.95	19.95	_____
☐ Turbo Pascal Database Toolbox	99.95	29.95	_____
☐ Turbo Pascal Graphix Toolbox	99.95	29.95	_____
☐ Turbo Pascal Editor Toolbox	99.95	29.95	_____
☐ Turbo Pascal Numerical Methods Toolbox	99.95	29.95	_____
☐ Turbo Pascal Gameworks	99.95	29.95	_____

Total product amount	$ _____
CA and MA residents add sales tax	$ _____
In US please add $5 shipping and handling for each product	$ _____
Outside US please add $10 shipping and handling for each product	$ _____
Total amount enclosed	$ _____

Please specify diskette size ☐ 5¼" ☐ 3½"

Payment ☐ VISA ☐ MC ☐ Check ☐ Bank Draft

Credit card expiration date: _____/_____

Card # _____

†To qualify for the upgrade price you must give the serial number of the equivalent product you are upgrading.

Peachtree Brings Its Accounting Classic up to Modern Standards

PC HANDS ON

BY MIKE FALKNER

Peachtree Software, the granddaddy of PC accounting package makers, has performed a face-lift on its $199 *Peachtree Complete II: The Business Accounting System*.

The new main menu uses three windows to help you locate the function you want. Although the menus streamline the selection of functions, the window-drawing routines are slow. To counteract this problem, *Peachtree* provides shortcut key sequences.

Once you are past the menus, the basic operation of the package is much the same as the previous version. However, *Peachtree* has again used the new window look to help you recall master file information from within entry programs. When you come to a question that verifies a list or a master file, you just type the F2 function key to display a window with the acceptable choices.

As it worked on the cosmetics of the product, Peachtree also added features to each of the modules. Many of the report programs now allow you to select ranges of data and create listings of only the information you need.

The General Ledger now contains 13 accounting periods, reversing entries, consolidated financial statements for multiple companies, and monthly budgets and prior-period reporting. Accounts Receivable now has user-defined aging periods, user-defined terms codes, and a service invoicing in which you can enter free-form text for each item on the invoice. Accounts Payable has been enhanced to easily handle void checks, partial payments, and multiple checking accounts. The remaining modules have been improved as well.

Even though Peachtree has upgraded it, the product still has a few bad habits. Transactions are posted immediately instead of in batches. You have to manually expand files when they are full. Even the new windowing could use some fine-tuning to run smoother.

Peachtree Complete II includes a hefty array of features for an inexpensive package. The new changes help to streamline the product and indicate Peachtree's willingness to continually improve its software. At $199, it's still a good contender in the low-end accounting package market. PC

Peachtree Complete II: The Business Accounting System *now uses windows to display up to three levels of menu choices. To start a process, you can use either cursor keys, the letter next to the choice, or predefined shortcut keys.*

PC MAGAZINE FACT FILE

Peachtree Complete II: The Business Accounting System
Peachtree Software Inc.
4355 Shackleford Rd.
Norcross, GA 30093
(800) 247-3224
(404) 564-5800
List Price: $199; upgrade from Version 1, $99 plus $12.50 shipping.
Requires: 384K RAM, 10MB hard disk drive, 132-column printer (or compressed 80-column printer), DOS 3.0 or later (update disk for DOS 2.1 available upon request).
In Short: A welcome upgrade to the prior version that adds more features, windows, and file lookups to the user interface. Not copy protected.

CIRCLE 441 ON READER SERVICE CARD

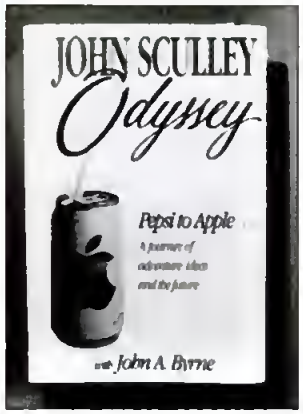
Battling IBM as if It Were Coca-Cola

PC BOOK REVIEW

BY DONALD B. TRIVETTE

A low-flying plane pivots into a death roll and heads for the ground; at the last moment it pulls up and executes a series of loops and rollovers that show there's an accomplished pilot at the controls. Finally the plane lands and the pilot, in his early seventies, welcomes his weekend houseguests. "Just wanted you young hotshots from Apple to know us old-timers still have guts," says the host. That is how John Sculley describes his first meeting with the legendary Tom Watson, Jr., of IBM.

Odyssey is the autobiographical account of Sculley's journey from a fast-track executive position at PepsiCo to the presidency of Apple Computer.



The book is full of anecdotes about both companies. It was with Sculley that Jobs, the cofounder of Apple, got his first look at Armonk—and was so underwhelmed by IBM's architecture that he wanted to fly his entire staff in to see the homely world headquarters of their archrival.

This is a book that even those who know nothing about Apple will enjoy. Not only did it make me want to try a Macintosh II, it awakened a long-dormant thirst for a Pepsi. PC

PC MAGAZINE FACT FILE

Odyssey: Pepsi to Apple
By John Sculley with John A. Byrne
Harper & Row, Publishers
10 E. 53rd St.
New York, NY 10022
(212) 207-7000
ISBN: 0-06-015780-1
Copyright: 1987
List Price: $21.95
In Short: John Sculley's entertaining story of his years at the helm of both Pepsi and Apple Computer with a lot of good shop talk.

CIRCLE 442 ON READER SERVICE CARD

Photograph Thom O'Conner

New! Introducing Turbo C 1.5

the best optimizing compiler gets even better!

The professional optimizing compiler for less than $100

Turbo C® is a technically superior production-quality compiler. (Borland's equation solver, Eureka™, is written in Turbo C.) And our Turbo C 1.5 offers a new library of the highest presentation-quality graphics in the industry—the kind you'll see in Quattro,™ our new professional spreadsheet.

And spectacular graphics are just part of the brand-new features. Turbo C 1.5 enhancements also include:

- A professional-quality graphics library of over 70 functions
- A librarian that allows you to build your own object module libraries
- Context-sensitive help for the language and the library routines

Actual photograph of Turbo C graphics displayed on IBM 8514 screen

Turbo C 1.5 gets you into great pictures and adds dazzling new features

- Text/video functions, including windows
- 43- and 50-line mode support
- VGA, CGA, EGA, Hercules, and IBM 8514 support
- File search utility (GREP)
- Sample graphics applications
- More than 100 new functions

For professional-quality C at an affordable price, no one else comes close to Turbo C. Because no one can deliver technical superiority like Borland.

60-Day Money-back Guarantee*

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(800) 543-7543

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Minimum system requirements: For the IBM PS/2™ and the IBM® and Compaq® families of personal computers and all 100% compatibles. PC-DOS (MS-DOS®) 2.0 or later. 384K

*Customer satisfaction is our main concern. If within 60 days of purchase this product does not perform in accordance with our claims, call our customer service department, and we will arrange a refund.

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BORLAND

It's easy to upgrade to Turbo C 1.5!

Just complete this coupon and mail it with payment before June 30, 1988. Or, call us at (800) 543-7543 and be ready to give our operators your name, credit card number, and the serial number on your Turbo C master disk.

Turbo C 1.5 Upgrade Price	***$ 33.50***	Please specify diskette size ☐ 5¼" ☐ 3½"
CA and MA residents add sales tax	_____	Method of Payment ☐ VISA ☐ MC ☐ Check ☐ Bank Draft
Shipping and handling In US $5.00 (Outside US add $10)	_____	Credit card expiration date _____/_____
Total amount enclosed	$ _____	Card #

If the world had one computer communications standard you wouldn't need Crosstalk Mk.4

The fact is, today's bewildering variety of computers demands a program like this — an entirely new generation of communications software.

CROSSTALK® Mk.4 helps your PC perform up to 15 concurrent sessions with all mainframes and minis through IRMA™ and Smart Alec.™ It works with most popular modems... emulates most popular terminals... and supports the most widely used file transfer protocols.

Its language, CASL,™ is designed specifically for communication for experts and novice operators alike.

Maybe all computers can't be identical. But now at least they can communicate. For more about CROSSTALK Mk.4, see your dealer or contact us.

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COMMUNIQUÉS

edited by Bill Howard

BUSINESS & FINANCIAL

Stocks Start Downward Ascent During Week Ended Oct. 14

Why computer magazines shouldn't try to be The Wall Street Journal. *(Headline from* Computer Reseller News, *October 26, 1987.)*

Continental Drift

"Our membership administrator . . . mentioned that we have members in all 50 states, including Canada, West Berlin, and Saudi Arabia."

—*Scott Sherer, President's column,* Technical Support, *the mogozine of the Notionol Systems Programmers Association, July/August 1987*

Department of Apt Analogy

"C. Itoh seems to like to build printers like Sherman tanks, and the Jet Setter is no exception. Measuring about 30 feet by 15 feet by 8 feet and weighing 66 pounds, the printer takes up a good bit more deskspace than either the Ricoh-based machines (like the Tandy, Okidata and Epson lasers) or Hewlett Packard's sleek new Laserjet II."

—*Brian Starfire, Knight-Ridder computer columnist, November 2, 1987*

But Is It Built Like A Sherman Tank?

"AST TurboLaser: Postscript page language, 35 resilient Adobe fonts, 300x300 dpi, 8 pages per minute, 3 MB RAM, $3495."

—San Jose Mercury News, *November 3, 1987*

Classified Intelligence

Programmer analyst. Design, analyze, develop, modify, test & debug of a real time enhancement in a network environment . . . must have pacific knowledge & expertise in the Unix System V . . .

—Newark *(N.J.)* Star-Ledger, *November 17, 1987*

IBM PC. NEC monitor, Epson dot matrix printer & Olympia daisy wheel, Gas Turbo Pascal Assembler & Basic. Lotus 123, WordPerfect, R-base 5000 and extra software. $2700. Call xxx-xxxx, ask for Elmer.

—Monday Morning *(Columbia, Md.), November 16, 1987*

IBM AT—20 meg hd, 2 kb memory, in hands color monitor & printer. Sftwre also. $3100/bo. xxx-xxxx

—The Washington Post, *November 14, 1987*

Printronix Printer, Work Horse, 150 lines permitted, multi-part forms, PC compatible, excellent for mailing service, $1000. Bob xxx-xxxx.

—Houston Chronicle, *November 17, 1987*

Manager Moose with TelePaint for IBM-PC or Compaq 286, new, trade for desk utility . . . or sell for $50.

—The Signal *(Fort Gordon, Ga.), November 4, 1987*

There are only two ways to protect against power line disturbances.

What's wrong with this Computer Accessories ad (PC Magazine, November 24, 1987)? The graph is in color. The monitor is IBM's Personal Computer Display.

Heard or seen anything offbeat, unusual, or just plain dumb about the computer industry? Send your offerings to Communiqués, PC Magazine, One Park Avenue, New York, NY 10016, or MCI Mail 157-9301. Please print your name legibly; include the name, city, and publication date of any newspaper clipping; and include your T-shirt size. Contributors receive $50 and a PC Magazine T-shirt. In case of duplicate entries, the earliest postmark prevails. Sorry, but entries can't be acknowledged

Winners for this issue: Randy Swart (in hands monitor), Saul Rubin (pacific knowledge), Dottie Wiman (150 lines permitted), Dave Bowles (Gas Turbo), Hugh Lokey (Manager Moose), David Shaw (membership in all 50 states), Richard Flynn (monochrome color display), Bill Steele (downward ascent), David Poole (30-foot printer), Gregg Morris (resilient fonts).

Illustration: Harley Schwadron

Stanford 386-18 [redacted] $2058

9/18 MHz Zero Wait State
21 MHz Throughput

- Intel 32 Bit 80386 CPU (18 MHz), 9/18 MHz software (keyboard) switchable clock
- Norton SI: 21 (Processor Speed)
- 200 watt P/S, 110/220V selectable
- CMOS memory, 16 channel interrupt, 7 DMA channels
- 512K interleaved 32 bit RAM on board
- RAM can be expanded to 16 MB of 32 bit high speed interleaved memory
- 2-32 bit, 4-16 bit & 2-8 bit expansion slots
- Supports 80387 math co-processor
- (Phoenix BIOS optional) Award BIOS
- High capacity floppy contoller card
- 1.2 MB floppy drive
- Serial port (Com 1), optional 2nd serial port (Com 2), parallel port & (optional) game port
- Hardware Reset and Turbo L.E.D.
- Clock/calendar with battery backup
- Enhanced keyboard (101 keys)
- Complete documentation included
- High quality, heavy duty packaging

Stanford 386-16/1 [redacted] $1979

6/16 MHz Zero Wait State
19 MHz Throughput

Same configuration as in System 386-18 except,

- Intel 32 Bit 80386 CPU (16 MHz), 6/16 MHz software (keyboard) switchable clock.
- Norton SI: 18.7 (Processor Speed)

Stanford 386-16/2 [redacted] $1884

Same configuration as in System 386-16/1 except includes socket for 80287 math coprocessor.

Stanford 286-12 [redacted] $999

6/12 MHz

Same configuration as in System 286-16/1 except,

- 80286-10 CPU, 6/12 MHz Switchable.
- 512KB 100 Nano Seconds, 0 wait state DRAM, installed

Stanford 286-16/1 [redacted] $1344

10/16 MHz Zero Wait State
16 MHz Throughput

Same configuration as in System 386-18 except,

- Compact size AT main board
- Intel 80286-12 CPU, 10/16 MHz software (keyboard) switchable clock
- Award BIOS, Norton SI: 15.9
- 1024KB (one megabyte) 80 Nano Seconds, 0 wait state DRAM, installed
- Selectable between zero wait state (10/16 MHz) or one wait state (8/12 MHz)

Stanford 286-16/2 [redacted] $1169

10/12 MHz Zero Wait State
16 MHz Throughput

Same configuration as in System 386-18 except,

- Compact size AT main board
- Intel 80286-12 CPU, 10/16 MHz software (keyboard) switchable clock
- Award BIOS, Norton SI: 15.3
- 1024KB (one megabyte) 80 Nano Seconds, 0 wait state DRAM, installed

Stanford 286-10 [redacted] $948

6/10 MHz

Same configuration as in System 286-16/1 except,

- Regular size AT main board & chassis
- 640K (120 N/S) DRAM on board
- Phoenix BIOS
- AT/XT style keyboard
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Stanford 4.77/10 [redacted] **$499**

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- Phoenix BIOS. Norton SI: 3.3
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Stanford 4.77/8 [redacted] **$399**

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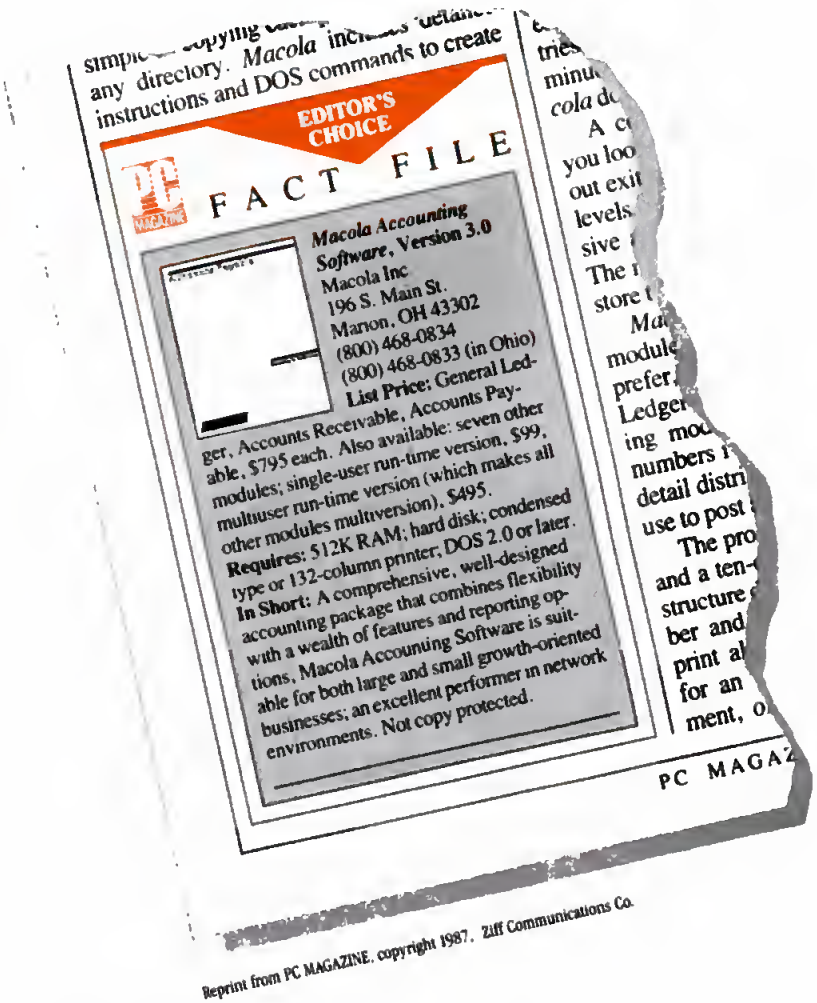

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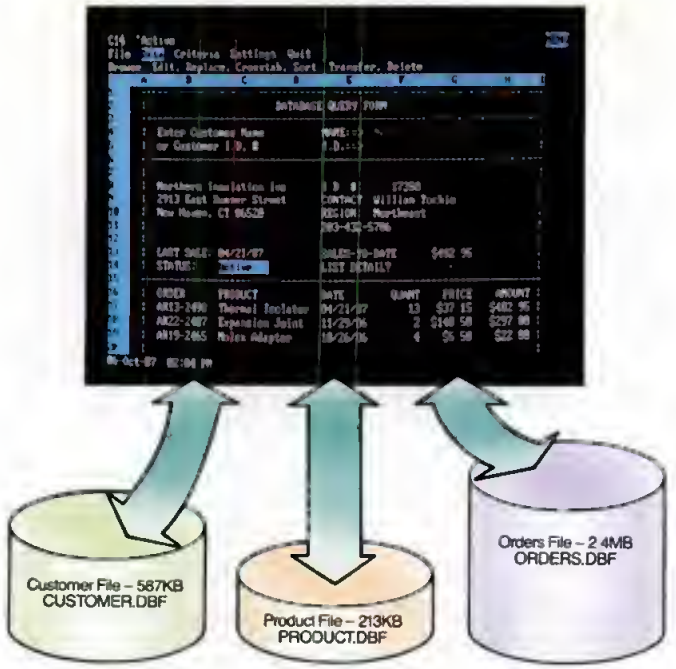

dBASE Power for 1-2-3

Last year we met a crazy programmer who said he could build a database with the power and capacity of dBASE and put it *inside 1-2-3*. Well, he works for us now, and if you know anything about database programs, his baby is going to knock your socks off.

Introducing @BASE, a full-feature relational database add-in for 1-2-3. Now anyone who knows how to use 1-2-3 is an instant database wizard because @BASE turns 1-2-3 into a powerful "front-end" for database applications. *It's as easy as 1-2-3.*

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If you've every tried to use 1-2-3 as a database manager, there's a good chance you've run out of memory. That's because 1-2-3 stores data in the worksheet. @BASE stores data on disk where record capacity is virtually unlimited. You'll never run out of memory again.

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@BASE compares with powerful stand-alone database programs like dBASE or R:BASE,® but it operates in concert with 1-2-3. You get the best of both worlds. 1-2-3 gives you tools for data analysis. @BASE gives you big data capacity. Brains and brawn. It's a nice combination.

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Industry-standard file format

@BASE uses exactly the same file format as dBASE III and dBASE III Plus. *dBASE is not required to use @BASE.* But if you have standardized on dBASE, @BASE fits right in. @BASE reads and writes dBASE files directly. No conversion is necessary.

At less than a third the cost of dBASE, you may decide to use @BASE instead of dBASE throughout your organization wherever users need easy access to dBASE information.

Serious Performance

@BASE beats dBASE III Plus in benchmark tests.* @BASE is up to 3.7 times faster!

	dBASE III Plus	@BASE
Locate record	12 sec	12 sec
Pack database	7.1 min	1.9 min
Sort database	10.8 min	4.5 min

*Test with 4,000 records, 34 fields per record

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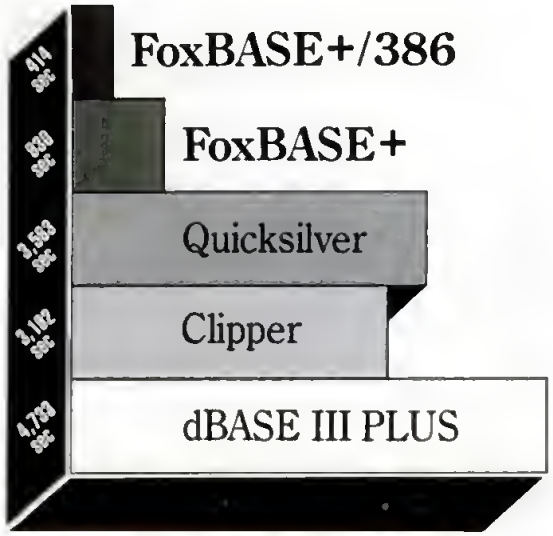

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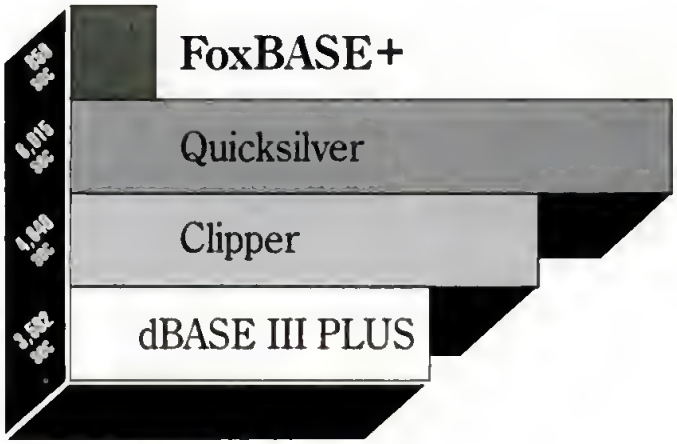

BYTE Magazine

FoxBASE+ Fastest By Far

BYTE* benchmarks show that FoxBASE+ takes only 14 minutes to do what dBASE III PLUS needs an hour to do. The others are even slower. Clipper needs an hour and 17 minutes. Quicksilver needs an hour and 40 minutes.

Nobody beat FoxBASE+ in ***even one*** of the 27 BYTE benchmarks.

FoxBASE+ zipped through the exhaustive Data Based Advisor** benchmarks in just 15.5 minutes. New FoxBASE+/386 ran them in only 7 minutes! By contrast Clipper took 53 minutes, Quicksilver took 59 minutes, and dBASE III PLUS took an hour and 18 minutes.

Why Waste Your Time?

BYTE's data shows FoxBASE+ is up to 7 times faster. DBA's benchmarks show FoxBASE+ is over 5 times faster.

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*Using the benchmark timings published in BYTE, September 1987.
**Using the suite of benchmarks published in Data Based Advisor, March 1987.

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CIRCLE 112 ON READER SERVICE CARD

■ BILL MACHRONE

80286 R.I.P.

The 80286 is a dead chip. It's been superseded by the 80386, which has everything that the 80286 was supposed to have. And yet the 286 is having its best year yet. Why?

I visit one or two user groups each month. It's great to get the feedback from these active user/readers. Typically, they're deeply involved in the specification and selection of computer equipment where they work. I ask a lot of questions about the hardware and software they use, the differences between their work and home machines, and their future plans for hardware and software.

One question I've been asking lately is, "What technology will take you through the end of the decade?" Only a tiny fraction, perhaps 2 percent, think that the 8088 will see them through. That makes sense. You can't build a bridge to the future on an obsolete technology. The 8088, after all, was designed in the mid-1970s.

The rest of the audience invariably splits fifty-fifty on whether they need an 80286 or an 80386. This makes sense; they are, after all, being torn in two directions.

WE WANT IT People want the 80286 because it's the next generation up from the still-predominant 8088. (There are 8 or 9 million 8088-based machines out there, and somewhere between 2 and 3 million 80286-based machines.) They want it because it runs three times faster than the 8088. They don't necessarily want it because of OS/2. A lot of users ask me if they're going to be forced to upgrade to OS/2 in order to stay current. It's begun to sink in that they don't have to even consider OS/2 until there's an application they want to run that isn't available in DOS, or that runs so much better under OS/2 that it's a fait accompli. Big, high-end database programs are likely to be among the first to weigh in. But 80286s in general, and OS/2 in particular, are not shaping up as the way to extend the life and utility of DOS applications.

The other half of the audience is fully prepared to skip a generation and go right to the 80386. They've got perfectly good reasons: The 80386 runs twice as fast as an AT. It does a far better job of emulating an 8088, in that it can emulate multiple 8088s. That makes multitasking old DOS applications a snap. (Well, relatively speaking. The programmers who did *Microsoft Windows/386* and *DESQview* didn't think it was such a snap, but at least it was doable.) The 80386 is also where Intel is putting its efforts in terms of faster clock speeds. Intel's thinking seriously about what it could be doing with 24 MHz.

Also, there's no 80286-specific software. Okay, OS/2 is technically 80286-specific, but I prefer to think of it as protected-mode-specific. In fact, the OS/2 development team had to program defensively around the 286's brain-damaged aspects, especially in memory management. The 80386 implementation of OS/2 will be easier, faster, and more flexible.

Illustration: Leslie Cober

The 80386 enjoys several applications, development tools, and utility programs that are 386-aware and use 32-bit instructions and other features to get the job done faster. Among applications, the 32-bit version of *Q & A* is notable. Development tools such as those offered by Phar Lap and utilities such as Bob Smith's *386ToTheMax* unleash the potential of the chip. And, of course, *DESQview* and *Windows/386* do a superb job of integrating your existing DOS applications.

DON'T COUNT IT OUT So it's all over for the 286, right? Wrong.

There's just one little obstacle—price. Even with the increased production of 80386 chips, motherboards, and machines, you still pay a premium of $1,500 to $2,000 for the privilege. Logic may dictate the 80386, but budgets have a way of speaking louder than logic.

The hardware manufacturers aren't making it any easier. A raft of lower-priced 286 machines was announced in November at Comdex in Las Vegas, and the manufacturers were gambling on a sure thing. One of the big gripes about OS/2 is that you need a pretty expensive machine to run it. The hardware folks have been doing everything in their power to remove that objection. These machines are cheaper and faster than ever and are fast becom-

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■ **BILL MACHRONE**

■ One of the big gripes about OS/2 is that you need a pretty expensive machine to run it.

ing the standard PC. Even though 8088-based machines are selling well, they are, as Jim Seymour likes to call them, nothing more than intellectually respectable terminals.

As the desire—no, demand—for 80386 machines builds, several lower-cost solutions are coming into view. One alternative is to build cheaper 386 machines. Intel will help to make this possible later in 1988 with the P9 chip, a 386 internally and a 286 externally. By using an AT-style bus, designers can build lower-cost machines. Memory upgrades, too, are cheaper and more flexible. You lose a little in performance but gain the 386 instruction set.

A PLOW WITH WINGS Add-in cards for the XT based on the 80386 have begun to make an appearance, too. We've already tested the PC Elevator 386, a coprocessor card that works in XTs and ATs. We've also been working with Intel's Inboard 386/PC. When Intel general manager Rich Bader told me about plans for the product last February, I frankly didn't think much of it. A racehorse hitched to a plow was how I characterized it. A lot has happened in the meantime to cause me to utterly reverse course.

The Inboard 386/PC comes with software that goes a long way toward eliminating the more plowlike aspects of the original PC. Disk-caching software speeds up access. An EMS 4.0 emulator softens the 640K barrier. And that delightful program with the unwieldy name, *386ToTheMax*, remaps memory, caches BIOS and EGA, and generally reorganizes things for maximum performance.

So our hearts say 80386, our budgets say 80286, and our reality says 8088. So start budgeting for those 386 upgrades. Mom was right—listen to your heart.

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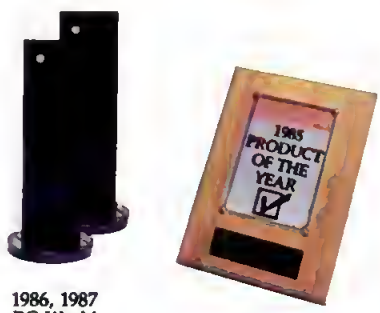

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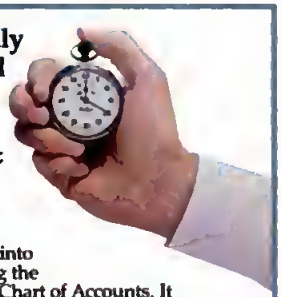

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TRBA

■ JOHN C. DVORAK

THE FILMLESS CAMERA FROM JAPAN

Forget about word processors and paint programs: the real future for the PC is in editing snapshots. It's part of our transformation into one-man minifactories.

The most interesting product at last November's Comdex wasn't new. The Japanese had already seen it months ago, while the once-savvy Americans paid little attention. It was the Canon RC-701 video still camera. At fall Comdex it was shown at the ICI Electronics booth, along with a Hitachi VY-100A color video printer used to show off the fancy D2T2 thermal transfer color dyes made by ICI. I don't think anyone who passed the booth had any idea what was going on.

It's the future. Not only will we one day take photos on floppies or plug-in RAM (or both), but we will manipulate them on our machines at home. Finally, a use for the home computer: a device to edit snapshots. We can transpose heads, remove unwanted people, make ourselves look a tad thinner, edit out an annoying mole. Photos will be manipulated in ways never seen before. And note: because the photo is on a cheap disk, there will be no reluctance to take tons of pictures because we'll know we can erase and reuse the disk—something we'll never actually do.

As usual, the personal-computer hobbyist/enthusiast is leading the way. He is already using a video camera to digitize images and play with them on his Macintosh or on a PC in full color using a Targa or Vista card. It's a ton of fun.

We're just playing, though. The Canon RC-701 is what it's really all about. The camera looks just like a 35mm camera with a little added bulk and a funny-looking viewfinder. The disks are those minute 2½-inchers from Maxell. They hold about a megabyte of information.

The photo from the output of the Hitachi printer looked like an SR-70 snapshot. Excellent. The filmless camera—a miracle.

FOTO FRENZY The first thing I thought to myself was, "Sheesh. Sell Kodak short." Then it dawned on me. I remembered the paperless office. From the first day the phrase "paperless office" was invented, all heck broke loose. From that day forward paper sales soared, probably never to retreat until every forest is laid waste.

As any computer user knows, we now have to buy paper products in bulk from any of the dozens of paper specialty stores that have cropped up like weeds around the country. Our garbage bins are packed with waste like never before. Paper, paper, paper. Everywhere.

That realization quickly made me think: "No, buy Kodak!" The new filmless camera will need dyes and filmlike processes.

Kodak will be there with floppies and printers. And mostly supplies, supplies, supplies.

This is what I really meant when I said we saw the future. Somewhere, somehow we are turning ourselves as individuals into unique systems—technological islands, each with our own fax, scanner, printer, and copier, and soon, a photo lab and retouching studio. This is not to mention video dubbing, editing, copying . . . you get the idea.

GET THE PICTURE? Nobody will claim that there is anything wrong with this. There is something Jeffersonian in the whole idea. But in all of this, something has snuck up on us: the cost. Our one-man minifactories aren't cheap. A laser printer figures to cost 7 cents a sheet to produce a printed page. When you amortize the cost of the printer with the paper and toner, it adds up. Copying machines are just as expensive. And this is buying in bulk!

You don't think of 7 cents a page after you crank out a 100-page printout, then decide to change the title and crank it out again. Seven dollars a crack doesn't enter into the equation because you've prepaid it all. Something's wrong.

This new camera technology will do it to us again. Prepaid and expensive, but you won't notice.

Marketers in this business are always looking for that great razor scheme in which you give away the razor and sell 'em the blades. Look no further than Japan. It manages to sell us the razor *and* the blades—at a premium. And we love it.

Illustration: Leslie Cober

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■ JOHN C. DVORAK

INSIDE TRACK

The Annual Comdex Report: Was 1987 the last hurrah?

Fall Comdex. Las Vegas. Each year before venturing into this miserable morass of goods, glad-handers, and glitz, I make a point of downing one stiff drink—a triple. Then I get on the plane and it's show time!

Last November's big show may have been the last hurrah for the industry if the economy turns down, maybe the last great show. **It was a doozy.** It began with a rainstorm that flooded the registration tent and most of the town, only to clear up for a day so as to surprise and redrench the 90,000 haggard showgoers as they headed for home. It was nature's idea to dampen their spirits if the stock market crash hadn't already done so. It didn't work. Everyone left with the same cocky overconfidence that made this business what it is today—bloated.

Vegas was bloated too, epitomized by a **40-foot-high, air-filled King Kong gorilla** that wore a T-shirt emblazoned with the letters DEI. A noisy gasoline-powered compressor, making the distinct noise of a Bronx cheer, kept it inflated. This thing was sitting in the middle of a perfectly good parking lot, across from the convention center, that had been fenced off to someday be used as a building site. The parking lot was sorely needed, and this tasteless ape and the sound of "the raspberries" **mocked** those who had to park rented cars a mile away and struggle through the rain to get to the show. It represented **the new Las Vegas—full of itself,** arrogant, a town once desperate for the convention business, now saying, "take it or leave it."

Each year there is a thematic character or stereotype roaming the floor at Comdex. This year it was the Joe Isuzu character. **Every other sales geek at the show looked and acted like Joe Isuzu**—the narcissistic liar on the Isuzu TV commercial. It was another **bad sign.** There was also something else at the show that I found curious. I ran into more characters on the show floor who **reeked of garlic breath.** One of the food concessions, I suppose, thought it was some sort of **foul joke** to lace the sausages or burgers with the stuff. In close quarters I almost gagged a couple of times. Everywhere you went you smelled it.

So against this backdrop of comedians, bad breath, and wet wool suits, what happened? First off, Comdex is where **IBM** announced the OS/2 ship date, prompting one cynic to remark that Microsoft's Bill Gates must be one smart guy to be able to get IBM to do his publicity—and for free. The announcement marked **a new trend to be watched.** Apparently, IBM's latest tack is to first announce a ship date far off in the future and then come in and beat that date. This supposedly makes people think there is some hot action and extra effort put into these things. Nice try.

Gimmicks were a theme of the show. I saw an interesting hologram in the AT&T booth that depicted a microscope. If you lined your eyeball up so that you could look "into" the microscope, you saw the AT&T logo. What a thrill. Also amusing were full-size photo cutouts of Cybill Shepherd and Tom Selleck at the Nestar booth, so you could have your picture taken with two-dimensional celebrities. Cheaper than the real 3-D versions, I suppose.

There were **plenty of celebrities** and near-celebrities here and there, including some of the old "M*A*S*H" lineup now shilling for IBM. I ran into artist Peter Max at the Sony booth, where he was showing off the pricey ($3,500) but slick full-color EGA printer. Meanwhile, Sony's monitors were aced by **Mitsubishi,** which had loaded the show with 35-inch killer-tube monitors used all over the place to show off various software programs.

Interesting unannounced products included the vertical recording version of the Siemens 777MB hard disk drive. The marketing honcho wouldn't say they had one ready to roll, but mentioned that it was a **5¼-inch, 1.4-gigabyte screamer** (wink, wink). That should take a few days to fill up. The 777MB drive goes for a $3,500 OEM price. An excellent price. It requires an ESDI or SCSI interface. This brings us to a question unanswered at this writing. **When will we see full DOS support for an SCSI I/O port?** It's long, long overdue.

The most-talked-about product, besides the plethora of much-talked-about 80386 machines and large display tubes, may have been ***WordPerfect* 5.0** and its inherent "desktop publishing" characteristics. *WordPerfect* can stay, but let's hope that the term "desktop publishing" goes away—soon.

The term prompted one group at the show to promote a custom T-shirt-making system called **Chest Top Publishing.** Various women were recruited to stroll the floor of the show wearing a T-shirt adorned with the words "Chest Top Publishing." I roamed the floor with our senior tech editor, Robert Hummel, and we saw a **buxom** and callipygous blonde gal wearing such a shirt. Hummel scratched his beard and commented, "Gee, I wonder if they have a braille edition?"

Later that evening, still chuckling over the wry remark, I looked at **60 pounds** of literature, shook my head, confirmed a flight out of town, turned on the TV, realized that I'd have to do this again next November, and had a good stiff drink—a triple.

MAN BUYS INBOARD 386; ENDS UP IN HOT WATER.

When Al Kerr outgrew his IBM PC AT,® he had two choices:

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Besides the price, how do they compare? According to a recent *InfoWorld* product review, "Inboard has the best computing speed of all micro systems we have tested to date," including all other 386 systems.

The reason Inboard is so fast is because of its zero wait state cache and 32 bit memory. To give you even greater performance, there's also a special socket for the 80387-16 math coprocessor.

Software compatibility is unsurpassed as well. According to *PC Week*, "The Inboard 386 proved perfectly compatible with a standard IBM PC AT and every software product we tested." It's fully compatible with advanced software, too, including 386 control software for multitasking. And a number of developers are already using Inboard to create OS/2® applications.

Of course, you're probably wondering if a ~~$2000~~ $1595 system can be as reliable as a $6000 one. Absolutely. Because it's built by the same company that designed the 80386 microprocessor. And it's backed by a five-year warranty.

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CIRCLE 326 ON READER SERVICE CARD

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■ JIM SEYMOUR

GETTING THE BIG PICTURE

The wonderful new big-screen monitors are good for more than displaying those special CADD and graphics applications. They're useful for text-based applications, too.

It often happens that when new kinds of products come to market, we pigeonhole them in narrow categories. In August 1984, for example, when IBM introduced the PC AT, there was a lot of mumbling about it being more computer than single users really needed. Except, of course, for engineering and scientific types, who might find something to do with all that power.

Otherwise, the word went, it would be used mainly as the engine for small multiuser systems, running the PC-IX UNIX variant IBM announced along with it. Even IBM itself encouraged that view, widely (if only briefly) promoting the PC AT as the heart of an affordable three-user system.

I think we're seeing that same phenomenon—viewing new computer tools as suitable only for special applications—once again, with the new larger-screen monitors.

The big-screen boom began last summer. Moniterm had been shipping 19-inch monochrome systems for PCs for more than a year, but as useful as big, high-resolution monochrome monitors are for many PC applications, black and white doesn't turn users on.

Color does.

A HEALTHY CHANGE The first generally available multi scanning 19-inch EGA monitor was the Microvitec Definition, shown at Spring Comdex in Atlanta. I had been screaming for a couple of years about the need for high-quality, affordable larger-screen displays, and so I got possession of one of the early Microvitec displays and set it up with the PC that I usually use for writing.

The result, 6 months later? You would have to blast this monitor away from me with dynamite.

That's because I'm doing a lot of CADD work, right? And I like to see those drawings blown up, to see the details? Nope; though I use *AutoCAD*, it's not on that machine.

That 19-inch monitor sits there 95 percent of the time displaying text. It's used primarily for standard business applications—which for now means character-based displays.

My vision is about 20/30, so I can see computer screens well enough. But the big monitor lets me sit back, relax, even work while leaning back in my tilted chair, keyboard on my lap.

Though we have all seen dozens or even hundreds of advertisements showing people working while casually sitting back, keyboard balanced on one knee, giving their PC's screen a contemplative squint, it's all a big lie. I have *never* seen anyone work that way. Though many of us would like to.

Keyboard cables are too short, but that's easily fixed with an extension cable. The real problem is that from a comfortable, contemplative position, we can't read the screen.

I don't mean to suggest that working tilted back in your chair, legs crossed, is the way to win a speed-typing contest, nor is it how you want to work 8 solid hours a day. But for short breaks—and especially for those times when you just want to casually reflect about the meaning of that worksheet, change one value in it, and think about what the recalc means—it's a healthy, productive change.

Big monitors make that possible.

BIG POSSIBILITIES The Microvitec Definition still stands at the head of the list for oversize multiscanning PC monitors (and the display works fine with PS/2s and Mac IIs too, with different cables). And at $2,195 list price ($1,650 or so on the street), it's a third less than other high-quality big-screen displays with similar specs. (See "Presentation-size Monitors Graduate to EGA," *PC Magazine*, October 27, 1987.)

Now we have oversize monitors on three PCs in my office. In addition to the Microvitec, there's a Moniterm 19-inch Viking I monochrome unit on a PC's Limited 286-12, usually used for desktop pub-

■ JIM SEYMOUR

lishing and *AutoCAD* work. And there's a spectacular SuperMac Sony 19-inch color monitor on my Mac II.

All of us who do our work on the PCs here scramble to get on one of those machines—no matter what program we're using. Because without exception, we find working on those big displays more comfortable, with far less eyestrain, than working at the other PCs here—even those that are outfitted with very good EGA and VGA displays.

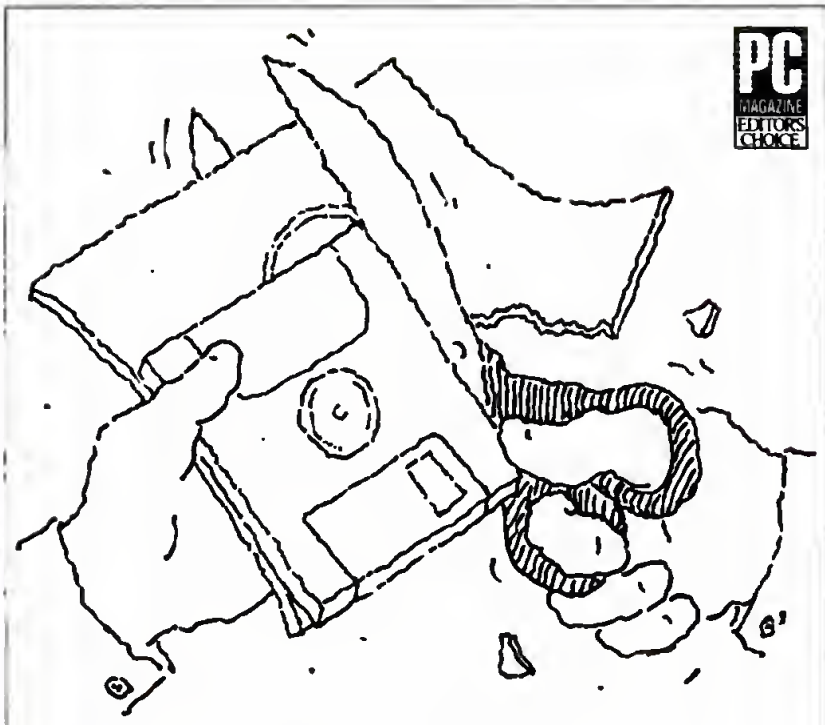
Working with them does make me wish for smarter hardware and software. On the Mac, for example, *Excel* and the SuperMac monitor are smart enough to show me not just the same number of rows and columns I'd get on a standard Apple display, in bigger type, but a larger area of the spreadsheet. On PCs I can get the same effect with *1-2-3* worksheets by using a utility such as the *1-2-3* add-in from Personics, *SeeMORE* (for a review, see "Living with Lotus" in this issue)—but why should I have to turn to a utility?

■ I can't argue that oversize PC monitors, at street prices of $1,700 to $2,700, are cost-effective or desirable for every single business use.

PRICE AND VALUE I can't argue that oversize PC monitors, at street prices of $1,700 to $2,700 (and about $4,000 for the SuperMac monitor-plus-video-board combination), are cost-effective or desirable for every single business use. For a start, not everyone has enough desktop real estate available to accommodate these behemoths.

But a year and a half of experience using oversize monitors on PCs has persuaded me that these tools have uses far beyond CADD, and that we miss a lot of their value if we see them only as special-purpose tools.

For anyone who uses a PC at least half of the day, both the reduced eyestrain and the reduced backache resulting from a much wider variety of possible sitting positions make 19-inch oversize monitors good investments, with fast (if hard-to-quantify) paybacks. PC



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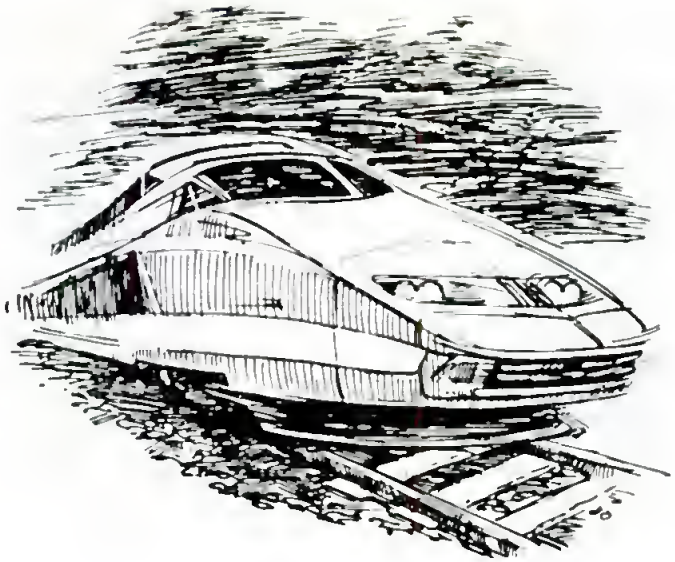
GV-286 "It coaxes extraordinary performance through the use of imaginative design and careful engineering." October 13, 1987

PC MAGAZINE

"The PC Designs GV-386 is one of the lower-priced 386 machines, but its quality is very good." December 22,1987



PC WEEK

GV-386 "the performance is the best we have found to date." May 26, 1987

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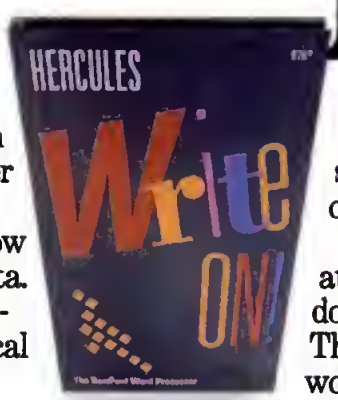

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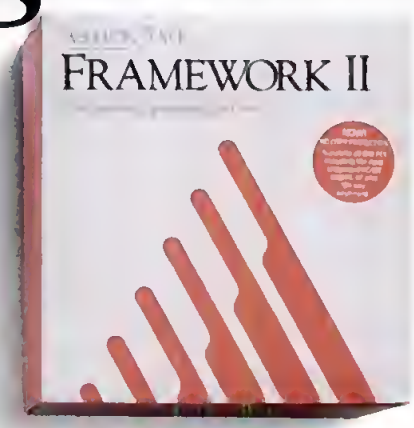

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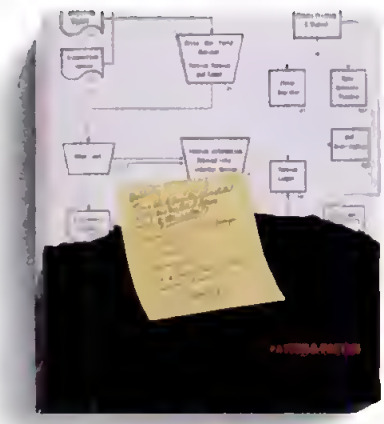

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■ STEPHEN MANES

TYPE "TYPE": HOW'S THAT AGAIN?

When uncaring dealers ineptly "install" brand-new systems, columnists learn new routines all too reminiscent of the palmiest days of Abbott and Costello.

"Type 'TYPE AUTOEXEC.BAT'," I instruct my latest unpaying "client."

"What?" replies the baffled woman at the other end of the line.

"Type 'TYPE AUTOEXEC.BAT'."

"One more time. Tell me again what you want me to type."

"TYPE AUTOEXEC.BAT. T-Y-P-E . . ."

"You want me to type TYPE?"

"Yes. Type TYPE."

"Upper- or lowercase?"

"Either way."

"Okay. I did it. Now what?"

"AUTOEXEC.BAT."

"Spell it."

"A-U-T-O-E-X-E-C-period-B-A-T."

"Okay. Nothing happened."

"Press the Enter key."

"Okay. Now it says 'Bad command or file name.' "

"Is there a space after the word TYPE?"

"You didn't say anything about a space."

"Sorry. Try again. Just retype what's up there on your screen. But add a space between the TYPE and the AUTOEXEC .BAT."

"Hang on." I hear clicking in the background. The frazzled woman on the phone is not some computer-illiterate from a backward country; she and her husband have had a Xerox CP/M machine since before the IBM PC was invented. Negotiating the brave new world of MS-DOS, however, hasn't exactly been a picnic. "Do I press the Enter key?"

"Right."

"Okay." There is a long pause.

"Okay. I did it."

"What do you see on your screen?"

"Gee! A bunch of stuff!"

"Right. Read it to me. Top to bottom."

"DATE. TIME. MODE COM1 colon 6. MODE LPT1 equals sign COM1. LPT1 with a greater-than sign and then COM1. PATH C colon slash. PROMPT dollar sign P, dollar sign G. Then C colon slash again and a greater-than sign. I think that's what they call the prompt, right?"

Right. And that AUTOEXEC.BAT file is what I call a scandal. The dealer who stuck that thing on there should be forced to trade his inventory of IBM PS/2s for Osborne Executives.

CLASSIC FARCE All my "client" originally wanted to do was buy a PS/2 Model 50 and hook it up to her ancient Diablo serial daisy wheel printer. She dutifully visited her official IBM Advanced Products Dealer and plunked down the going tariff for the beast—plus $127 to have some kid on the dealer's crack staff lug it to her house and "install" it.

Regrettably, the kid couldn't get the old Diablo to work quite right. It would print for a while and suddenly poop out. No wonder, given that AUTOEXEC.BAT file. Serial printers are tricky, and an old Diablo can't keep up with the 600-bit-per-second speed the MODE command sets, especially when the important P (for Printer) parameter is missing. For want of a P, the printer was lost. Mr. Dealer and his crack staff never did find a solution.

But since the Model 50 worked fine, my "client" never considered sending it back or asking for a refund of her $127. Instead, since the once-friendly dealer was now behaving like some cut-rate ayatollah, she went out and bought a brand-new parallel printer from a discounter. When she hooked it up, it self-tested fine. But talk to the computer it would not. Discounter blamed computer. Computer dealer blamed printer. Then both blamed the cable, which she actually replaced. It took the "Who's on first?" phone call to diagnose the simple redirection problem in the fourth line of the AUTOEXEC file. When the computer's sending LPT1 output to COM1, not much is likely to appear at the parallel printer.

Rather than attempt to explain how to create an ASCII file from a word processor, I step my client lightly through the mysteries of COPY CON ("Now hold down the key marked Ctrl and press Z") to

Illustration: Leslie Cober

■ STEPHEN MANES

create a new version of AUTOEXEC .BAT. "Now reboot with Ctrl-Alt-Del," I instruct.

"Huh?"

"Hold down the Ctrl key and the Alt key—oh, forget it. Just turn your machine off for a second."

"Okay."

The requisite pause. "Now turn it on again."

We make sure the printer is loaded, on, and on-line. We execute a Shift-PrtSc. Lo and behold! Printerly noises emerge from the printer!

I decide to have her press on and make sure the word processor is installed properly. "Okay," say I. "Now type backslash WP. And the Enter key."

" 'Bad command or file name.' "

"Weird. What does it say above that?"

■ What is the moral of this story? The first is that MS-DOS, after three major and many minor iterations, is still too hard to learn and use.

"TYPE backslash WP."

"This time don't type the TYPE."

"Just backslash WP?"

"And the Enter key."

"It says C colon slash WP."

"Okay. Now type WP slash I."

"W. P. Slash. I. Enter key. 'Bad command or file name.' "

"Weird. Try again."

"W. P. Slash. I. Enter key. Same thing. 'Bad command or file name.' "

"Hold on. Are you typing a slash or a backslash?"

"What's the difference?"

I am trying to think up a clear, unambiguous description when my "client" says, "Oh, you mean that one under the question mark?"

I do. It works. A few minutes later we have the word processor and the printer working in tandem. They've been working fine ever since. I just hope this poor woman does not decide she desperately needs a modem.

IT AIN'T FUNNY What is the moral of this story? The first is that MS-DOS, after three major and many minor iterations, is still too hard to learn and use. Big firms can afford to hire somebody to spend hours

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Actual speed of file transfers (speeds are given in bps)

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WITHOUT COMPRESSION	1178	2046	2278
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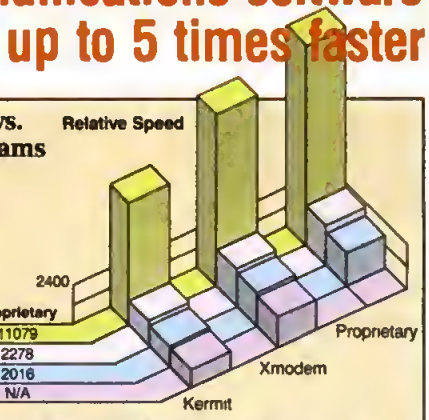

HyperACCESS is faster than the modems' baud rate because, in file transfers to other copies of HyperACCESS, it compresses *as it sends*. Even with compression off, its Xmodem and Kermit are noticeably faster than other programs, yet they remain fully compatible with other programs. Test conditions: IBM XTs and 2400 baud modems were used to send a 34K Lotus worksheet file

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CIRCLE 340 ON READER SERVICE CARD

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Terry: It's the same with home accounting finances, Roger. I can get my personal net worth in *seconds* since Light instantly reflects the effect of changes, payments, withdrawals and deposits.

Roger: Light gives me the option of handling accounting on a cash or accrual basis. Plus, if I forget any account or customer, I can quickly call it up in a window.

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Roger: Terry, for once I think you're right. Light's so smooth and easy to handle, *even you can use it.*

Terry: And you're right, too, Rog. Using Light, you'll have more time to spend on the golf course. I just hope you're not trying to compete with my *hall of fame game!*

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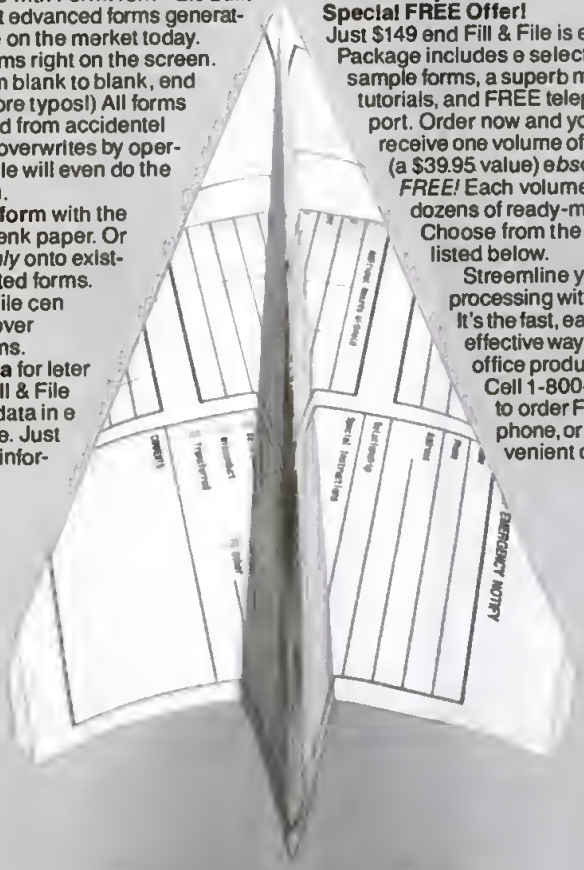

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CIRCLE 174 ON READER SERVICE CARD

■ STEPHEN MANES

creating menu shells and insulating workers from anything they find difficult. The rest of the world has to muddle along trying to guess why the manuals don't seem to make sense. I reread IBM's documentation on the MODE command, and I still don't fully understand it—and I deal with such things for a living.

If you think Windows or GEM will help, think again. They're largely cosmetic paint jobs for a rusty old clunker.

Moral Two is that there are still a lot of terrible dealers out there proudly displaying the Authorized IBM banner. I had hoped things had changed since the dark ages when IBM's own Product Centers couldn't tell me whether my new-model floppy drives were double-sided, double-density, or both. Clearly they haven't.

■ Moral Two is that there are still a lot of terrible dealers out there proudly displaying the Authorized IBM banner. I had hoped things had changed since the dark ages.

The presence of the TIME and DATE commands in an AUTOEXEC.BAT file for a machine with a built-in real-time clock prove the dealer's incompetence. Even worse, there's no CONFIG.SYS file on my "client's" hard disk—meaning, among other things, that IBM's much-ballyhooed cache, the only possible salvation of the piggy Model 50 hard disk, has never once been operational.

I'll have more to say about this dealer mess in a future issue, so if you've had any extraordinary (or do I mean "all-too-ordinary"?) experiences with your vendor—good or bad—drop me a line via U.S. or MCI Mail. As an exercise, you might try to improve on my "client's" classic comment: "They were so nice—until I bought it."

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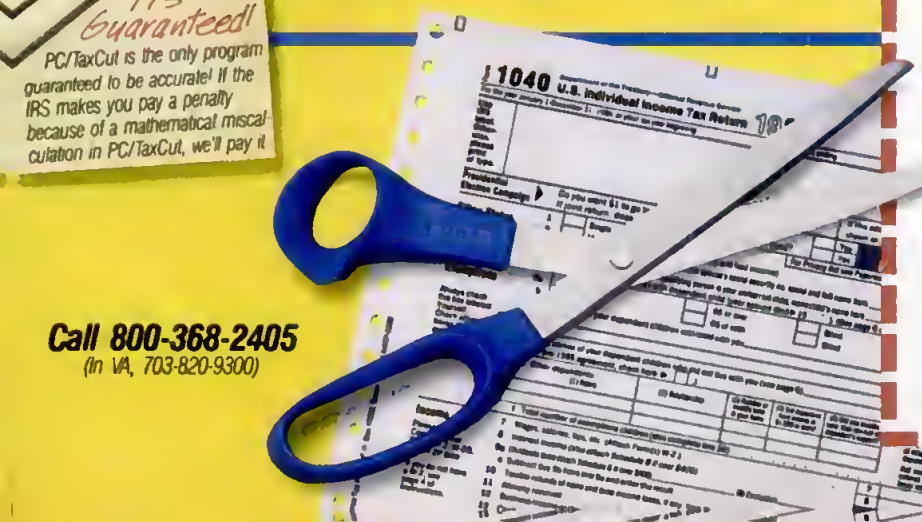

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CIRCLE 136 ON READER SERVICE CARD

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THE FASTEST

The Compaq Deskpro 386/20—it's the muscle car of computers, packing 20-MHz processing speed, the latest memory management technology, and universal PC compatibility under its hood.

The best way to tell this story is to start with the ending: Compaq's Deskpro 386/20 is the king of the PC hill. It's simple: You just can't buy anything faster. Or better.

Now let's jump to the beginning for a brief recitation of facts and figures. The Deskpro 386/20 is, as its name clearly states, an 80386-based, 20-MHz machine. It takes up to 16MB of dynamic RAM, and has 32K of high-speed static RAM for cache memory. It's available with 60MB, 130MB, or 300MB hard disk drives, and the top two units have ESDI disk controllers.

"Better" is a strong statement in this business. Here's why: Not only is the Deskpro 386/20 the fastest machine in every performance category, but it is likely the most compatible, too. Compaq has pointed with pride at its compatibility record and has often said that its machines are more IBM-compatible than IBM's. That's true.

IBM, steeped in mainframe days and mainframe ways, has introduced numerous incompatibilities over time. Many have been small; all have been annoying. Compaq took the specifications and features of the PC, the XT, and the AT as gospel, then packed in more features, more speed, or both. At the same time, its engineering remained conservative, but creatively so. As processor speeds went up, Compaq separated the memory bus from the I/O bus, and dubbed it Flex Architecture. Under Flex, Compaq runs the memory at full speed, but keeps the I/O bus at a conservative, AT-standard 8 MHz. The result is compatibility with the full range of add-in cards. Most of these cards were designed for the 8-MHz bus; machines with 10- and 12-MHz bus speeds cause a variety of problems, including some you'd never expect. Put a multifunction card into one of these systems, and it suddenly starts saying, "General failure reading Drive C." Put a network card in, and it refuses to boot, even from a floppy.

Flex Architecture is most fully realized on the Deskpro 386/20 because of the new Intel 82385 chip, a memory management unit (MMU) and cache controller designed specifically for the 80386. The 386/20 is the first commercial application of the 82385. It won't be the last. Cache controllers are an important step in the development of high-speed/big-memory PCs. They allow full performance with smaller, less expensive dynamic RAM. Dynamic RAM isn't fast enough to keep up with the blazing speed of these new-generation machines. Static RAM, while fast enough, is expensive and bulky, because each bit in static memory requires six transistors instead of dynamic RAM's two. Even though the chips typically take less power,

RIDE AROUND

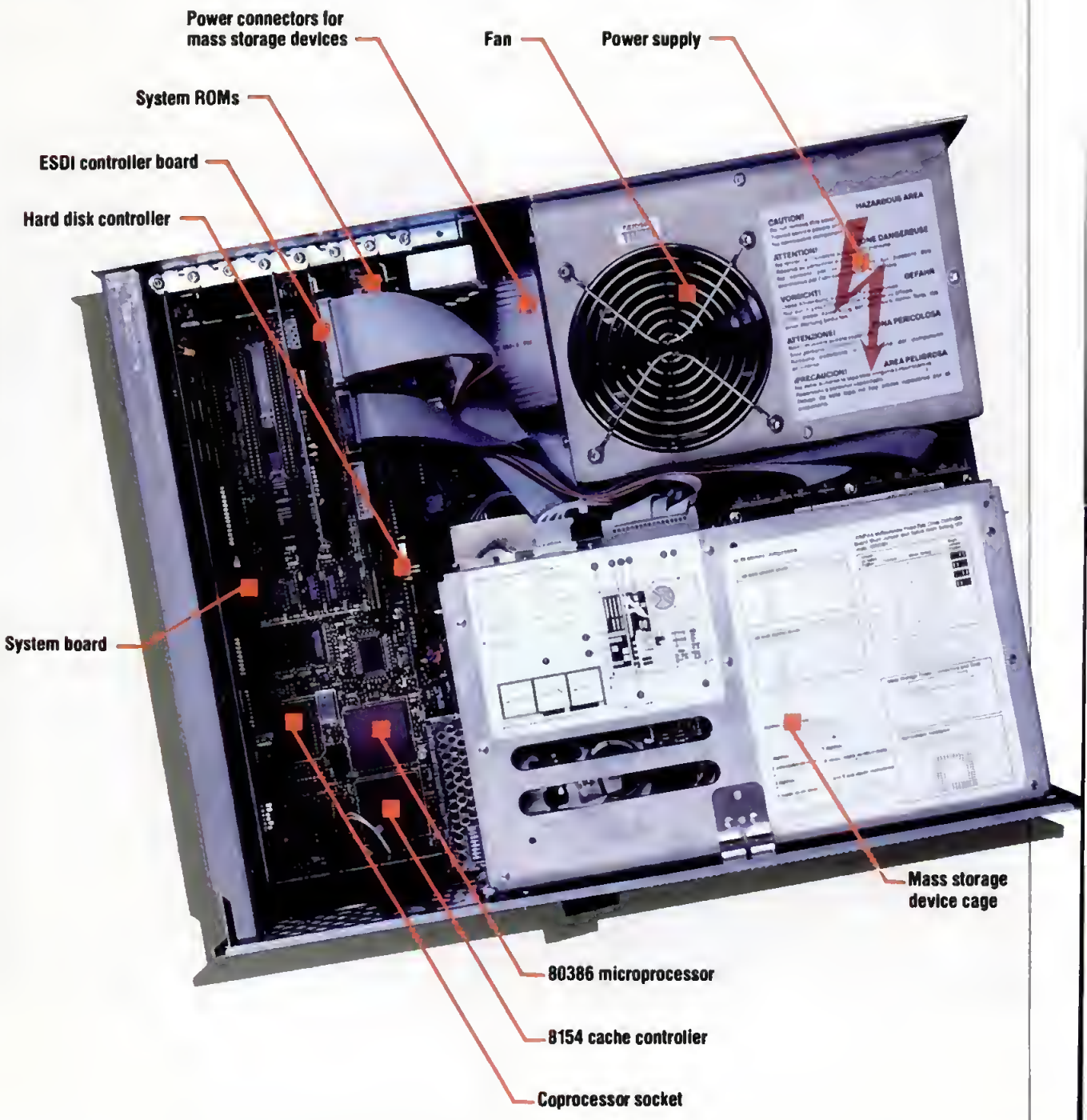
they take more room. You can match processor speed to dynamic RAM speed by inserting wait states into the memory cycles, but that's an inefficient use of expensive computing power.

The 82385 solves these design problems by watching everything the 80386 does. When it fetches data from memory, it loads the cache with more than the 80386 asked for. It's then very likely that the next data the 80386 asks for will already be in the cache. The 82385 does careful record keeping about when each chunk of memory in the cache was retrieved and when the 80386 last read it. The least-used chunks are tagged for replacement by future reads. Each time the 80386 writes to memory, the 82385 makes a copy in cache because many programs reread what they've just written in the normal course of events. The result is a memory system with a theoretical performance of zero wait states 95 percent of the time, even at 20 MHz. Even badly constructed programs, those that jump around a lot and continually cause the cache to reload, will average less than one wait state.

The dynamic RAM can be expanded easily by adding memory modules that come in 1MB and 4MB versions. The standard 1MB system memory board can

Photograph: Roberto Brosan

Inside the Compaq Deskpro 386/20



hold up to three modules of either size, so you can tailor memory up to 13MB as your needs and pocketbook allow. If you want to get to a full 16MB, you swap the 1MB system memory board for a 4MB board and attach three of the 4MB modules.

Compaq made a corporate commitment to producing the highest-performance machines when it shipped the Portable 286. The Deskpro 386, introduced a year ago, set the high-water mark for desktop machines. The Portable 386 did the same for portables, bypassing 16 MHz altogether and going right to 20 MHz. The Deskpro 386/20 continues this display of engineering prowess. In a time when computer design is such a by-the-numbers process that the machines are virtually identical inside, the Deskpro 386/20 is a continuing source of conversation and leaves the competition scratching their heads.

EGA EXCELLENCE Compaq's EGA board is a perfect example. In this day of VGA, EGA Plus, and other variations on the theme, Compaq's EGA board is deceptively ordinary. It only does 640 by 350 resolution and even lacks the IBM-standard (but seldom used) feature adapter. That annoys me a little, because it prevents you from adding an aftermarket oscillator to raise the EGA's resolution. This board's lack of a 640 by 480 mode is an oversight.

The board does one thing, however, that no other EGA can do: it can keep up with the 80386. EGAs, from the first IBM offering, have been terribly sluggish devices. Even at 8-MHz AT speeds, the EGA requires a couple of wait states each time you send it a character or a command. As processor speeds go up, the EGA's response time remains constant, requiring more and more wait states. At 16 and 20 MHz, the amount of processor time lost to waiting for the EGA begins to get ridiculous. Compaq's EGA requires zero wait states; consequently, the 386/20 clocked the fastest video test times we've ever encountered on any machine.

Video speed has a profound effect on the perceived speed of the machine. IBM's Models 50 and 60 feel faster than equivalent ATs because the VGA can accept and display characters about twice as fast as a standard EGA. Compaq's EGA is faster still. Compaq will be offeing a VGA-compatible board for the Deskpro series. If it matches the EGA in performance, it will doubtless be a winner.

Compaq's hard disk performance solution is more off-the-shelf. The 130MB and 300MB disk drives with their ESDI controllers are extremely fast (less than 20-millisecond average access time). These devices can read or write a full track with 1:1 interleave, which means that they never have to wait an extra revolution for a missed sector. The ESDI drives, like the EGA, alter your perceptual base of how PCs ought to perform. Programs act almost as if they were loading from RAM-disk rather than hard disk. The 130MB drive is aimed at high-end applications where huge files are commonplace, such as CAD, graphics, and program development. Compaq expects that the 300MB drive will find a home in file server applications.

A more conventional 60MB, 28-ms. drive rounds out the hard disk offerings for those who don't need big storage or the ultimate in speed. Compaq is also following the trend of including a disk caching program with the machine. Disk cache programs were popular aftermarket products, but many users regarded them with suspicion until IBM included a disk cache program with the PS/2 line. Of course, IBM did it to overcome the rather porcine nature of their hard disks, but at least they legitimized the concept.

Compaq also includes CEMM.SYS, the Compaq Expanded Memory Manager.

The new cartridge drive in the Compaq Deskpro 386/20 is enormous and fast: it holds 135MB and backs up at a rate of 5MB per minute.

It emulates Lotus/Intel/Microsoft expanded memory in 32-bit extended memory. In our tests, CEMM performed adequately, but not spectacularly. Software emulation of hardware always pays a price in overhead, even on a fast machine.

Big disks need big backup, and Compaq was a pioneer in offering integral tape backup in its original Deskpro machine. The original DC1000 and DC2000 tape formats, however, don't cut it when it comes to backing up 100MB or more. So Compaq expanded its offering with a DC600XLT cartridge drive that holds 135MB of error-corrected backup. It also threw in *Sy-TOS*—a new tape backup software with a user interface virtually identical to that of *Sy-Stor*, a recent *PC Magazine* Editor's Choice.

Space isn't the only frontier when it comes to backup. The Deskpro 386/20's new cartridge drive and software transfer data at 5MB per minute instead of the 1MB-per-minute rate of the DC2000 drive. Between reduced tape changes and increased overall transfer speed, the 135MB tape is the one to have, even for the 60MB drive. *Sy-TOS*, too, is a distinct pleasure compared with most tape backup

FACT FILE

Compaq Deskpro 386/20
Compaq Computer Corp.
20555 FM 149
Houston, TX 77070
(713) 370-0670
List Price: Model 60, with 60MB hard disk, $7,499; Model 130, with 130MB hard disk, $9,499; Model 300, with 300MB hard disk, $12,499; 1MB RAM upgrade, $549; 4MB RAM upgrade, $2,099; 360K 5¼-inch floppy disk drive, $225; 1.2MB 5¼-inch floppy disk drive, $275; 1.44MB 3½-inch microfloppy disk drive, $245; internal 40MB tape drive, $799; 135MB tape drive, $1,999; monochrome monitor, $255; monochrome adapter, $199; color monitor, $799; enhanced color adapter, $399; 80387 coprocessor, $1,199; Weitek coprocessor, $1,999; DOS 3.3, $120.
In Short: The fastest desktop PC on the market today, incorporating all the latest technology, including Intel's memory management chip. It's expensive, but worth every cent.

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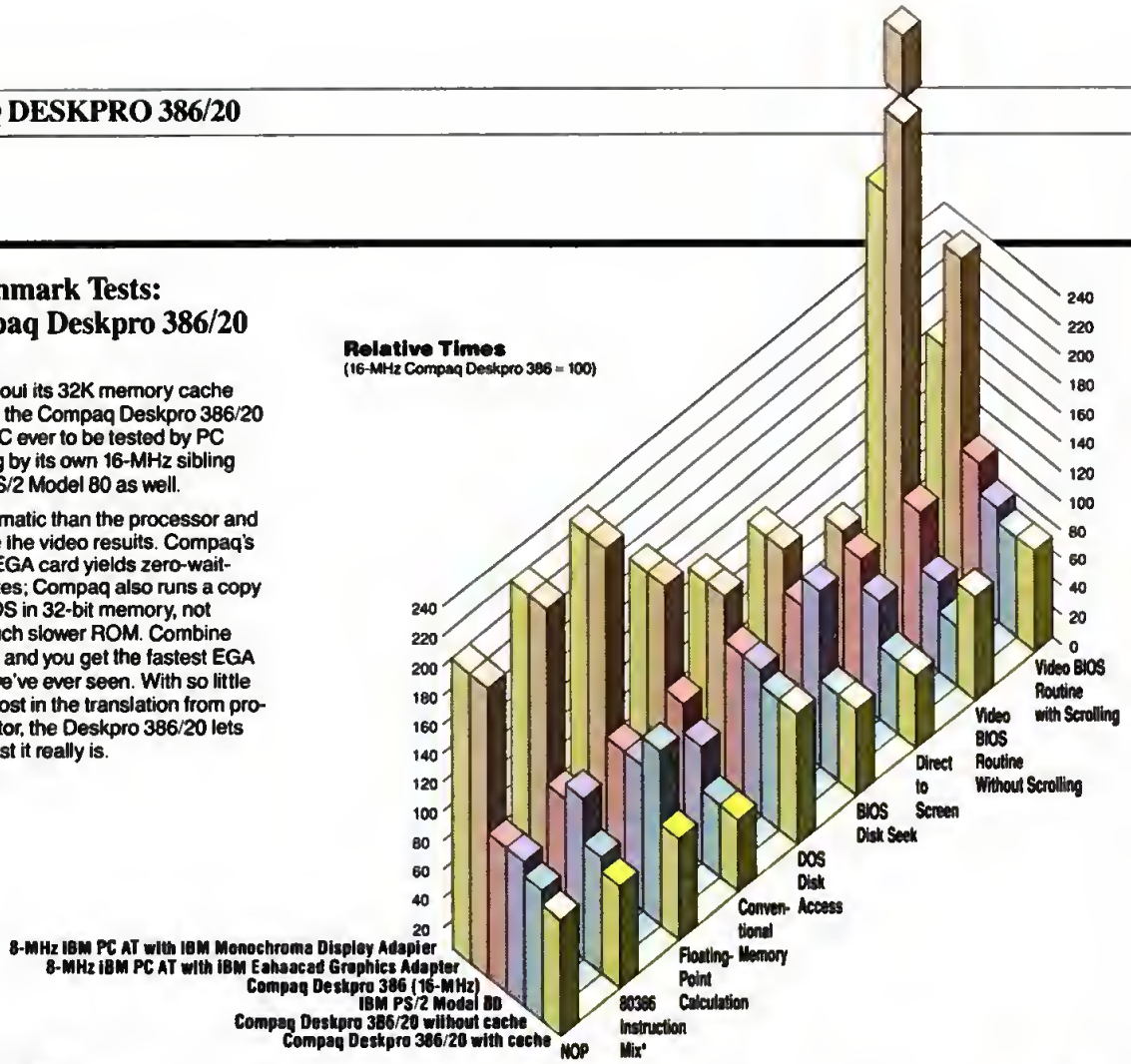
Benchmark Tests: Compaq Deskpro 386/20

With or without its 32K memory cache engaged, the Compaq Deskpro 386/20 is the fastest PC ever to be tested by PC Labs, speeding by its own 16-MHz sibling and the IBM PS/2 Model 80 as well.

Even more dramatic than the processor and disk results are the video results. Compaq's reengineered EGA card yields zero-wait-state video writes; Compaq also runs a copy of the EGA BIOS in 32-bit memory, not through the much slower ROM. Combine these two facts and you get the fastest EGA display times we've ever seen. With so little speed getting lost in the translation from processor to monitor, the Deskpro 386/20 lets you see how fast it really is.



Performance Times
(Times given in seconds except where noted)

	NOP	80386 Instruction Mix*	Floating-Point Calculation	Conventional Memory	DOS Disk Access (milliseconds)	BIOS Disk Seek (milliseconds)	Direct to Screen	Video BIOS Routine Without Scrolling	Video BIOS Routine with Scrolling
8-MHz IBM PC AT with IBM Monochrome Display Adapter	4.2	9.0	35.6	1.3	42.5	37.2	4.9	4.5	7.6
8-MHz IBM PC AT with IBM Enhanced Graphics Adapter	4.2	9.0	35.8	1.3	42.5	37.2	9.0	7.3	11.2
Compaq Deskpro 386 (16-MHz)	2.1	4.0	15.5	0.8	33.3	29.2	7.9	1.5	4.8
IBM PS/2 Model 80	2.1	4.4	15.6	0.6	33.3	33.6	6.6	0.9	3.7
Compaq Deskpro 386/20 without cache	2.0	3.4	18.9	0.4	30.0	18.6	4.3	0.7	3.3
Compaq Deskpro 386/20 with cache	1.7	2.9	10.5	0.4	29.5	16.1	3.7	1.1	3.2

*80286-based machines tested with 80286 Instruction Mix.

The **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **DOS Disk Access** benchmark test measures the time it takes to do a random sector read using DOS. DOS buffers are set at 3 and the interleave factor is left at the drive's default setting. This test adds DOS's overhead to the BIOS and hardware times. The test program performs the sector read 1,000 times within the DOS disk partition. The average result is shown in milliseconds.

The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

The **Direct to Screen** benchmark test measures the bandwidth of the video adapter by writing directly to the display memory buffer. The test is performed in video mode 3. The entire screen is updated using the assembly language REP STOSW instruction with register CX equal to 2000. This is done 1,000 times.

The **Video BIOS Routine Without Scrolling** benchmark test measures the speed of the BIOS Teletype routine without scrolling. The test is performed in video mode 3. The screen is cleared and 24 lines of 80 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. This is done ten times. The result shown is the total of the ten trials.

The **Video BIOS Routine with Scrolling** benchmark test measures the speed of the BIOS Teletype routine with scrolling. The test is performed in video mode 3. The screen is cleared and 240 lines of 80 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. Although the first 24 lines written to the display do not involve scrolling, all the remaining lines scroll the display.

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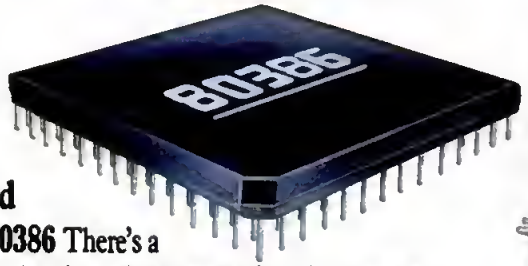
A Number of Reasons A Number



1. Designed for the 80386 There's a revolution taking place in desktop computing. A revolution that's been launched by a square wafer of silicon known as the 80386 microprocessor chip. It puts minicomputer potential at PC users' fingertips. It's a fact that virtually every leading PC manufacturer has built a "box" around this chip. And it's a fact that the "New Operating System" will, supposedly, even run on it. But, it's also a fact that *their* system wasn't designed for the 80386. Ours is. And it's called PC-MOS/386™

2. PC and PS/2 Compatible In designing PC-MOS, we knew our first priority was to exploit the minicomputer capabilities of 80386-based PCs & PS/2s. But we went further, and developed a system which would be fully compatible with the millions of existing PCs, PC ATs, and PC-compatibles. Power without sacrifice. You'd expect nothing less from the new standard bearer.

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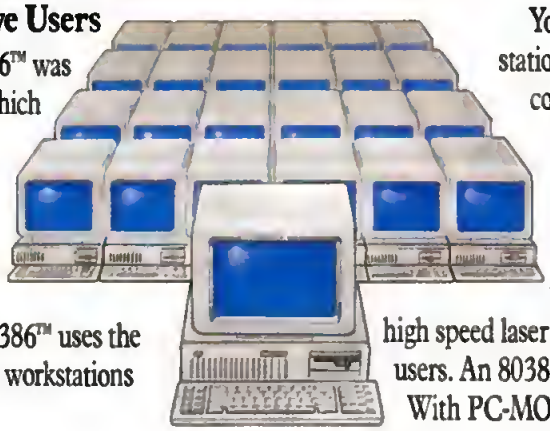
In a multi-user setting, PC-MOS/386™ uses the computing power of the host PC to drive workstations linked to standard RS-232 ports.



You can choose from a variety of workstations. Mix and match dumb terminals costing under $500 each with PCs and PS/2s running our terminal emulation software.

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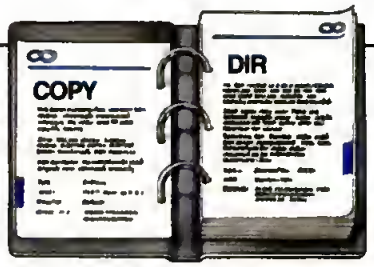
Think of it! Programs like dBASE III, WordPerfect, Lotus 1-2-3 and Symphony, WordStar, MultiMate...literally thousands of DOS programs–all compatible and multi-user available.

5. Familiar Commands Like DIR and COPY Just as you don't have to learn a whole new array of software to take advantage of PC-MOS/386™ neither do you have to learn an entirely new set of commands.



Instead, the system builds on the knowledge you already have. "COPY" still copies files, and "DIR" still gives you a directory listing. As you might expect, we didn't stop there. There's a wealth of features that have strengthened the commands you know, making them more powerful and easier to use.

# of Users Will Choose PC-MOS/386.

6. Concurrently Supports Virtual 8086 and 80386 32-Bit Mode

80386-based PCs & PS/2s are dual-personality computers. To run DOS programs, they act as PCs with a 640K memory limit. But to take advantage of their minicomputer capacity, they operate in true 80386 mode which lets them address up to four gigabytes of memory. PC-MOS enables the 80386-host and its workstations to independently switch between these modes–making DOS compatibility and 80386 power simultaneously possible.

7. Multi-Tasking

While it's true you could look elsewhere for multi-tasking, why would you want to? The *other* multi-tasking operating system is not now, nor is it planned to be, multi-user. It won't even run multiple DOS applications in multi-tasking mode.

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10. The Price...

As you evaluate operating systems, ask yourself if it's reasons you're considering...or rhyme. Ask if you're getting a system for tomorrow, or one that was made for yesterday. See if you're being forced to buy new hardware because of *their* software.

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■ COMPAQ DESKPRO 386/20

software. It does what you want it to, with a minimum of fuss.

An optional 3½-inch, 1.44MB floppy disk drive merges this machine into the world of PS/2s and laptops. All the floppy disk configurations, in fact, are optional. You can get a 1.2MB floppy or the normal 360K floppy. The 3½-inch drive only works as drive B:, but you'll probably never need to boot from it.

Compaq has signalled its intentions for this machine not only by implementing the 80387 math coprocessor at 20 MHz, but by designed-in compatibility with the Weitek 1167 floating-point chip set, the current darling of the workstation crowd. This potent processor can perform over 2 million floating-point operations per second, and it's just the ticket for math-intensive CAD programs. A number of popular CAD and scientific programs are being offered with 1167 support, and compiler manufacturers are on the verge of publishing 1167 libraries for their languages.

The Weitek/Intel marriage is possible because one of the chips in the set is an interface chip that adapts the Weitek signals to the 80387 pinout. Compaq had to add an extra set of pins to the 80387 socket, to accommodate the memory-mapped 1167. A daughterboard holding the three Weitek chips plugs into the oversized 80387 socket, and you move the 387 to the daughterboard as well. The 1167 is a memory-mapped device, not bus-oriented. Compaq addresses it high up in the 80386's address space. You get at it via CEMM, as though it were out in expanded memory. Our test machine had the 20-MHz 387 and was agreeably quick on our floating-point tests. As with the EGA, it logged the fastest times we've yet seen.

PHYSICALLY FIT The 386/20 is what you've come to expect from Compaq: a heavily constructed and strongly braced machine. Moreover, the Deskpro's keylock is the only non-IBM one I've seen that locks the cover as well as the keyboard. As far as I'm concerned, all keylocks should lock the cover. I've resigned myself, however, to Compaq's use of Torx screws instead of the more common Phillips or hex heads, and I suppose the people at Compaq have resigned themselves to our complaining about it.

In use, the Deskpro 386/20 feels unnaturally fast, even to jaded users of 16-MHz machines. One observer even accused me of running a demo program rather than the full program I was demonstrating. She simply didn't believe that any PC could retrieve screenfuls of data and pop them onto the screen as quickly as she was seeing. After a few minutes at the keyboard, she

You'll want Microsoft Windows/386 *even if you miss the introductory offer. On the Compaq, it performs quickly and smoothly, with no hitches or glitches.*

convinced herself that it really was that fast.

Compaq is bundling *Microsoft Windows/386* with this machine for the first 3 months, and you'll doubtless want it even if you miss the introductory offer. It performs quickly and smoothly on the system, with no hitches or glitches. It also multitasks your existing DOS applications. You should, however, allow a megabyte per application. That way each one gets its own 640K, with lots left over for disk caching and expanded memory. Compatibility is one of those things that you almost have to take on faith. You have to have faith that the manufacturer has covered all the bases. In this case, your faith is well justified.

The Deskpro 386/20 is a great machine, one that raises the performance ante. Other manufacturers are poised to respond. They may be able to equal the Deskpro's overall performance, but I doubt they'll surpass it. PC

Bill Machrone is editor and publisher of PC Magazine.

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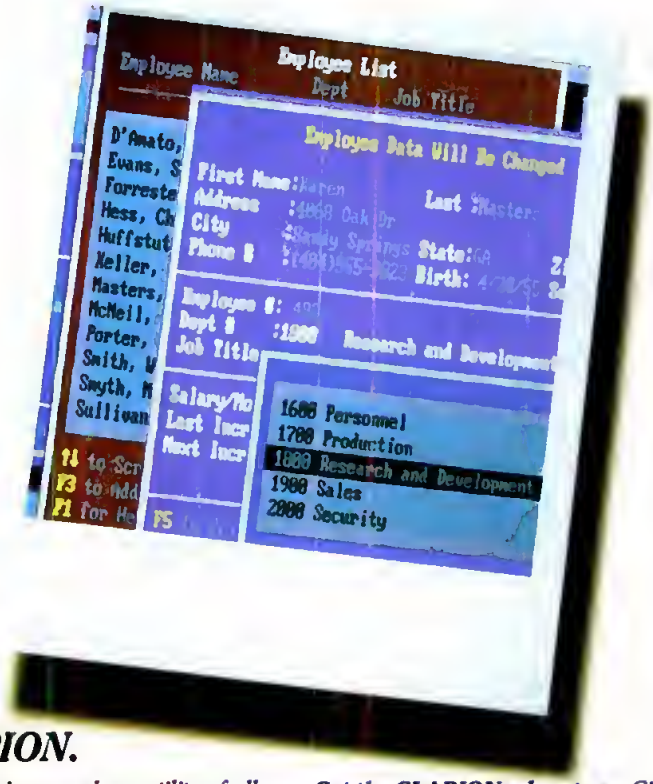

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ANATOMY OF A 386

Despite a shared chip, not all 80386-based PCs perform alike. Selections in clock speed ratings, coprocessors, BIOS versions, and bus structures can combine to produce machines of distinction.

In more than a few ways, 80386-based computers are like fine wines. To the uninitiated, they all seem the same. The feeling is bred by the thriving market for cheap, almost generic 8088-based XT clones and 80286-equipped AT compatibles. The advanced state of today's carbon-paper engineering almost guarantees that you can substitute one brand (or lack of brand) of AT clone for another with little or no change in either operation or performance.

Indeed, as with wines, the only apparent difference between 80386-equipped computers is the shape of the bottle—different chassis designs that might prefer one placement of disk drives over another. But it's what's inside that counts, and, with computers, the subtleties of taste and nuances of design can have a real effect—not just on how fast you can get things done but on what you can do.

The point was driven home with the introduction of *Microsoft Windows/386*. In its initial release, the new operating environment was compatible (according to Microsoft) solely with Compaq's 80386-based computer lineup. A more generalized version was scheduled for release later.

Some of the differences between computers are intangible. For instance, certain PCs have snob appeal based on brand name alone. Dropping one on your desk is like putting a Cherokee in your driveway or Romanée-Conti on your table. The IBM PS/2 Model 80 or Compaq Deskpro 386/20 on your desk says you can afford the best.

Along with the notoriety, name-brand machines can bring real, tangible benefits, too. For instance, part of the manufacturer's reputation is based on a commitment to support, processing speed, construction quality, and the simple reassurance that a reputable company probably won't close up shop and leave you holding a bag full of malfunctioning microprocessors.

No single 80386-based PC ranks as best on all counts. You don't get status and low price in the same package, for instance. All practical computer packages inevitably embody some compromises. Because of the higher prices of the technically advanced parts needed to boost performance to its limits, faster machines inevitably

tend to be more expensive. (The relationship between speed and price is not always proportional, however, nor is the more expensive machine necessarily faster.) Other equipment may incorporate features that will endear it to you in particular situations. For instance, big, fast hard disks can work wonders for a network, and built-in communications ports can benefit a multiuser installation.

Finally, not everyone needs an 80386-based computer. If you plan on using a computer for just one job—for instance, keeping books or making them—you won't need the multitasking power of the 80386. If you're looking for the most performance per dollar spent, mail-order high-speed AT compatibles are still among the best bargains around.

But if you're concerned about the future, the PCs equipped with the 80386 microprocessor are the only way to go. Not just faster, they are architecturally superior to everything that's come before in the IBM environment. Settle for something less today, and you'll rue your decision tomorrow.

WATCHING THE CLOCK Undeniably, the biggest allure of 80386-based PCs is performance. A machine that runs twice as fast as an ordinary 80286-based AT will potentially get your work done in half the time. Once applications that use 32-bit code become available, that performance level will likely double again on the same equipment without any other change.

But when it comes to performance, all 80386-based PCs are not created equal. While the latest heavy-duty 80386 hardware promises to triple or quadruple the throughput of plain ATs on ordinary DOS software, some systems won't even double the AT level of performance.

No one factor can explain these surprising differences. The performance of 80386-based computers varies with clock speed, memory type, and overall system architecture.

The most obvious—and most publicized—difference between various 80386-based computers and PCs in general is clock speed. Advertisements are full of claims quoting number of megahertz; in today's commercial 80386-based PCs the bottom end is encountered at about 14 MHz and the top at 20.

The clock in question has little to do with the time of day—it counts nanoseconds instead of hours. Its function is to keep the computer's electronic thoughts straight. It works more like a metronome, beating time to keep all the parts of the machine humming along in harmony.

The clock is necessary because computers process information in the form of very brief electrical pulses. Each pulse is dealt with separately, in a linear sequence, one after another. The computer understands a digital state—the smallest piece of information: a bit—as the presence or absence of a pulse at a given instant.

The most obvious—and most publicized—difference between various 80386-based computers and PCs in general is clock speed.

Although electricity moves quickly, it doesn't move instantaneously. Circuit resistance slows the pulse and stretches it out because a pulse has to overcome both the resistance and reactance (mostly capacitance) of the computer circuits and components. Consequently, some discrete period is required for the full power of a pulse to travel from one part of a computer to another—and different lengths of time are required for moving between different parts of the computer.

The system clock synchronizes all the pulses by allotting a given period for moving the electrical charges, then triggering the various computer parts to see what they have—whether they have received the electrical equivalent to a logical one or zero—at the instant of the clock trigger. Once all the pulses everywhere in the system are registered, the system can begin to shift signals around anew.

The rate at which these clock beats recur thus determines how fast information can move through the system. The faster the clock, the quicker bits are recognized and processed. But the speed of the clock cannot be increased without limit. At some point, increasing the clock speed may call on the computer to register information before all the pulses in the computer have reached their destinations. In addition, a faster clock operates at a higher frequency (by definition), and higher frequencies are more likely to leak between connections and register false results. Both of these conditions can cause errors.

Computer chips, too, are rated to operate at certain clock rates, limited in speed by their internal resistances and reactances as well as by their power consumption and ability to dissipate heat. A clock that's too fast can confuse the chips and make them work unreliably.

Clock speed is measured in megahertz: millions of cycles (or pulses) per second. The 80386 microprocessor is designed to operate in its slowest form at 12.5 MHz. Faster versions are rated to run at 16 or 20 MHz. This rating is mostly a recommendation. The 80386 chip can, in general, run faster than the rating screened on its case, but reliability decreases (often dramatically) as the clock speed is increased.

The clock speed inside most personal computers is determined by the very precise vibrations of a thin slice of quartz crystal. This crystal may be in a metal package by itself on the computer system board or it may be combined with other circuits into an oscillator module. In either case, in 80386-based computer systems the crystal and oscillator frequency is twice the speed at which the microprocessor operates. The chip itself cuts the clock speed in half internally before using it. In other words, an 80386 that operates at 16 MHz actually requires a system clock that can operate at 32 MHz.

With rare candor, every maker of 80386-based PCs reports the actual operating speed of the microprocessor chip and not the system clock speed on the computer bus.

All else being equal, the throughput of a computer—how much information it can actually process—is directly related to its clock speed. A machine that runs at 16

MHz will find answers twice as fast as one operating at 8 MHz.

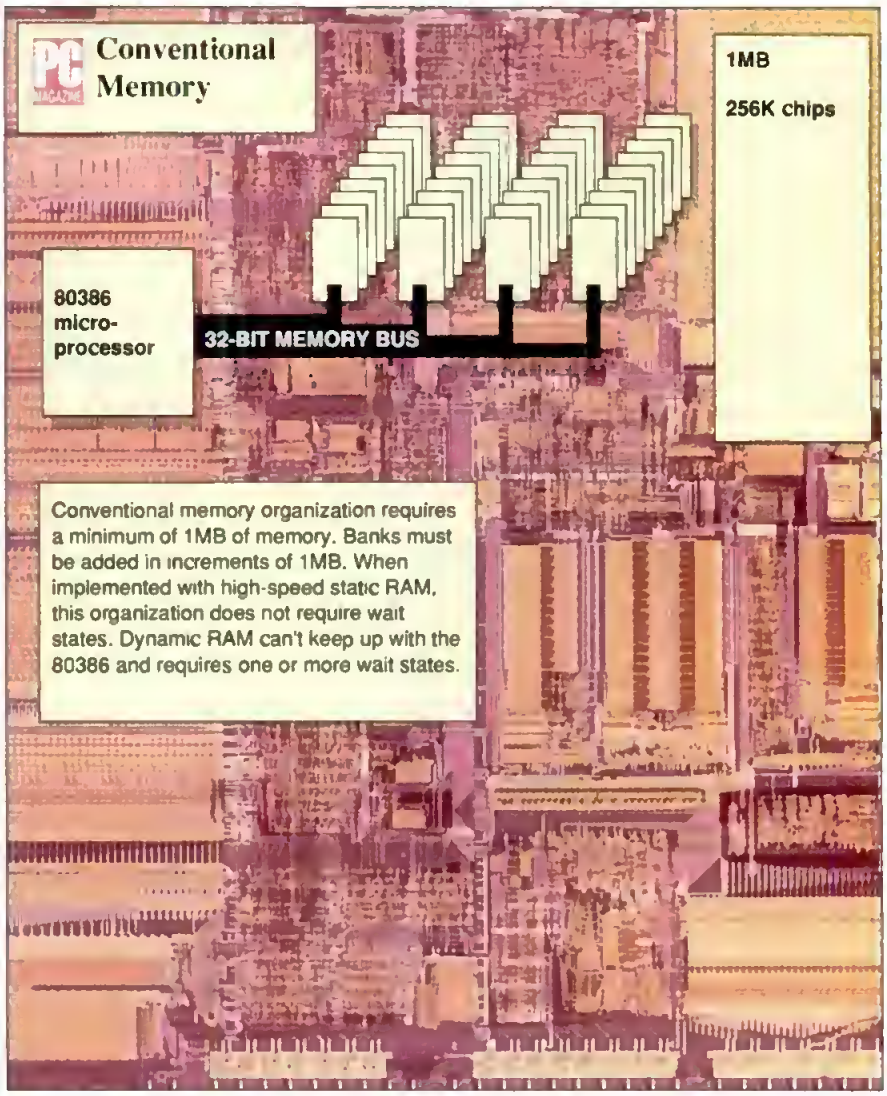
Of course, all else is rarely equal. Different microprocessor designs running at the same clock speed can work through problems at different rates. Factors that influence processing speed include the size of internal registers (where calculations actually take place inside the microprocessor) and the microcode used by the chip.

The more bits in a register, the bigger the chunk of a problem that can be worked through in a given processing cycle. In theory, a 16-bit computer can do twice as much work per clock cycle as can an 8-bit machine. A 32-bit chip like the 80386 would be faster still.

Such speed projections assume that all the bits of a register are put to use. PC-DOS poses a problem for the 32-bit 80386, however, because it uses at most half the space in a 32-bit register. When working on PC-DOS programs, the 32-bit architecture of the 80386 is really of no benefit.

Even chips that have the same size registers solve problems at different rates. The microcode of a microprocessor determines what bit patterns cause the chip to carry out what operation and how that operation is performed. While one microprocessor might require 7 simple operations to carry out a complex task like adding two numbers, another chip design may require 17.

For instance, although the 80286 microprocessor in the AT has the same size registers as its predecessor, the 8086, it can perform roughly five times as much work at less than twice the clock speed. Clock rates are thus only a rough guideline that should be used to directly compare similar chip models operating in similar environments.



MOVING MEMORY In 80386-based computer systems, the clock speed is one indication of how fast a given machine can perform. But in many high-performance computers, including most 80386-based PCs, the clock speed determines only how fast information is processed inside the microprocessor chip itself.

The speed at which the information is sent to and taken away from the microprocessor—both from memory and from mass-storage and other system peripherals—is another factor that affects the performance of the total computer system.

The 80386 microprocessor operates so quickly that most memory chips cannot keep up with it. To prevent the microprocessor from outrunning the memory chips, most 80386-based computer systems periodically force the chip to stop whatever it's doing to give the memory chips a chance to catch up. Because the microprocessor is essentially doing nothing but waiting around, these pauses are called "wait states."

The number of wait states is counted for each memory cycle. A memory cycle normally requires three microprocessor cycles—one for the microprocessor to send out an instruction telling the memory system which bytes it wants to read, another to find the bytes, and a third cycle for the memory system to send the requested information back to the microprocessor. Adding one wait state will increase each memory access from three to four cycles, slowing down the system by 33 percent. Some 80386-based computers may, at times, have to endure 2 or 3 wait states per memory cycle when accessing system board memory and sometimes 16 or more wait states when they read from memory expansion boards.

The reason that wait states are necessary at all is that most PC designs use Dy-

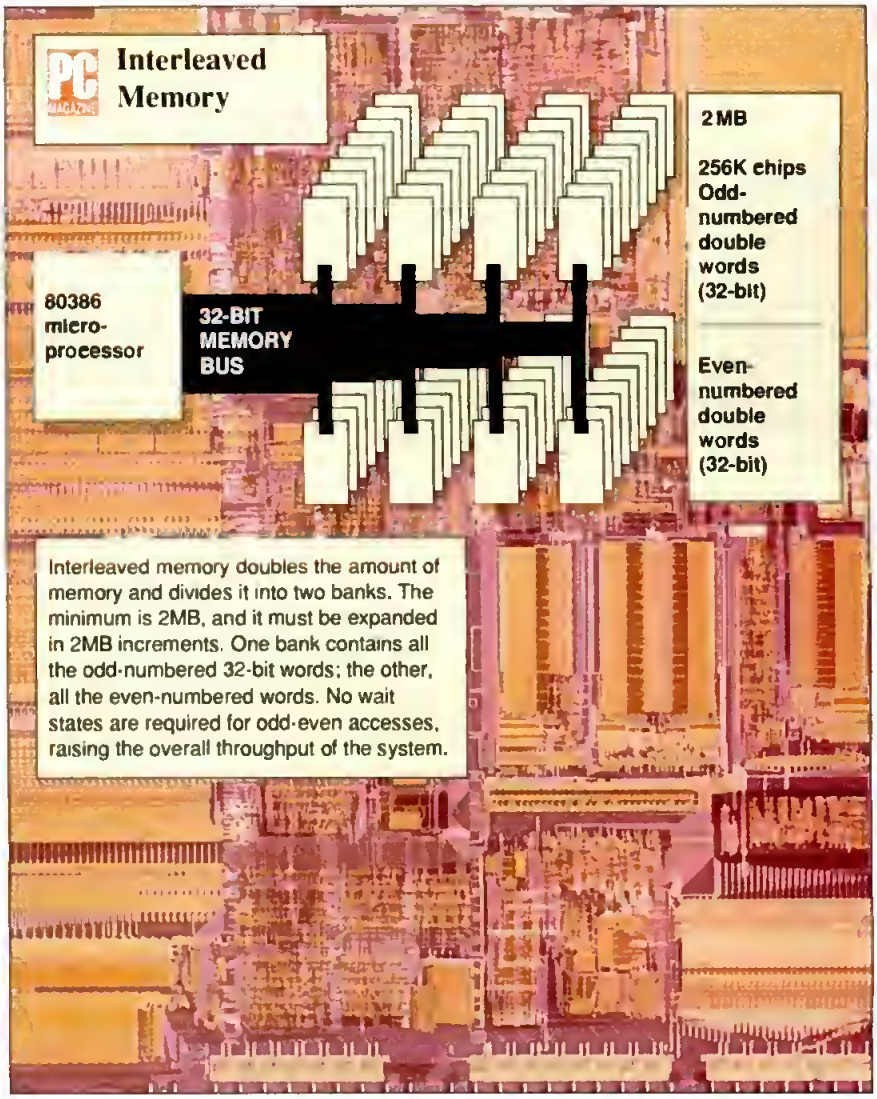
namic Random Access Memory (DRAM) chips. DRAMs store information as minuscule electrical charges, akin to the static electricity that bites your hand when you touch a doorknob during dry winter months. As with static electricity, the charges stored in DRAM chips tend to drain off on their own. To prevent this brain drain, DRAM chips are periodically refreshed. Each stored charge is given a small boost to keep it from fading. Computers can devote from 6 to 12 percent of their time to refreshing memory, even if their memory chips are never accessed.

In addition, the very act of reading a bit of memory tends to weaken its charge, and in many cases the chip must be refreshed before it can be read again. Recharging a memory chip requires a small but substantial amount of time, roughly from 100 to 500 nanoseconds (billionths of a second). If the microprocessor attempts to read from a DRAM chip before it has been completely refreshed, it may gather erroneous data. So the microprocessor waits.

Most people are familiar with the speed ratings of memory chips, given in nanoseconds. Perform some simple math, and you might think you could calculate the speed rating necessary for a computer—three cycles of a 16-MHz clock requires 187.5 ns. But 200-ns chips won't work with zero wait states in a 16-MHz 80386 computer. In fact, such a machine requires memory chips that are rated faster than 80 ns.

"Every DRAM chip has an access time specification that relates to how fast you can get data after you ask for it. That's the number on top of the chip that people are familiar with," explains David Lunsford, systems architect, Dell Computer Corp., Austin, Texas. "All chips also have a cycle time which describes how often you can ask for data. With dynamic RAM the cycle time is much longer than access time. For example, an 80-nanosecond DRAM chip has a cycle time of 190 nanoseconds, so the most often you can ask for data is every 190 nanoseconds."

One way to avoid the wait is obvious: make the DRAM chips faster. Faster chips are, however, more expensive and may not be readily available. In fact, few DRAM chips are quick enough to keep up with an 80386 operating full-tilt at 16 MHz, and those that are tend to be expensive. Nevertheless, NCR Corp. achieves zero wait states in its Model 916 through the use of 70-ns. DRAM chips.



A different style of memory chip, called Static Random Access Memory (SRAM), can achieve substantially faster cycle times. Static RAM chips work on a different principle than their dynamic cousins. Rather than storing information as static-like charges, each memory cell of an SRAM chip works like a two-way switch, latching itself in one position or another. A tiny charge of electricity is constantly supplied to each cell to keep the switch locked in its particular position. Because current is constantly supplied, the chip does not need to be refreshed. It does away with both the refresh time the computer requires and the need for wait states to recharge the RAM.

Without the need to refresh, the cycle time is no longer important. "With static RAM, the access time and the cycle time are exactly the same, so you can ask for data from an 80-nanosecond chip every 80 nanoseconds," says Lunsford.

To achieve zero-wait-state operation, the PC's Limited 386-16 uses fast static RAM for all of the main memory of the system. The static RAM of the 386-16 also eliminates the need for memory refresh,

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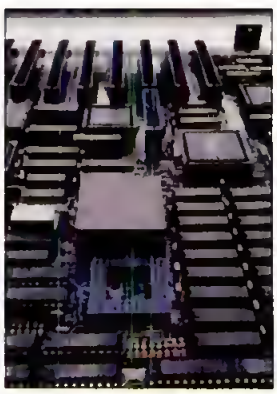

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However, static RAM has a major disadvantage: it's much more expensive than DRAM, and the chips don't hold as much information.

STATIC SUBTERFUGE To sidestep the need for huge banks of expensive static RAM chips, computer makers can use several strategies to make DRAM memory appear to work faster. These techniques are based on the principle that most memory accesses that computers make tend to be confined to a narrow range of addresses, often sequential. Only a few software commands—those to jump to a new memory area and those that call subroutines—break away from sequential operation. By optimizing the speed at which a computer can read sequential bytes, overall system throughput with modest-performance DRAMs can be raised to nearly the level afforded by SRAM.

The most straightforward of these strategies is the fast memory cache, often using SRAM chips. This technique uses normal DRAM chips but adds a block of extremely fast memory chips that serve as a buffer between the microprocessor and main memory banks. When the microprocessor requires a certain byte of memory, it is read directly from the DRAM and loaded into both the microprocessor and the fast cache. Alternately, a whole block of bytes can be read into the cache whenever a memory request is made. If a subsequent memory request asks for a byte that's kept in the cache, it can be retrieved with zero wait states. The only time wait states are encountered is when the next instruction cannot be found within the memory cache.

The odds are in favor of bytes being in the cache, according to Gary Stimac, vice president of systems engineering for Compaq Computer Corp., Houston. "Almost all programs are designed to loop with respect to frequently used data. For instance, in *Lotus 1-2-3* the actual calculation of cells is a loop that just gets duplicated time and time again," he says.

The "hit ratio"—the percentage of the time that the microprocessor actually finds the bytes it needed in the high-speed cache—varies somewhat with the number of bytes in the cache itself. The cache may be as small as a couple of kilobytes or as large as 64K, the size used by the PC Designs GV-386. Caches much larger than that don't make sense because they approach the size of main memory.

Even with modest cache sizes, manufacturers claim hit ratios as high as 90 percent—Compaq claims 95 percent for its 80385-controlled 32K cache of its Deskpro 386/20 Model 300—although the actual value depends on the software you're running. With an adequately large cache and amenable applications, a system equipped with cache memory can run nearly as fast as one with no wait states.

"Nobody knows what will happen with OS/2. Nobody knows what will speed it up or slow it down."

The caching technique is preferred by most manufacturers of 80386-based turbo boards (expansion boards that add an extra high-performance microprocessor into an existing computer) and allows them to nearly double the performance of the host computer. The fast cache memory operates at 16 MHz along with the turbo board 80386 microprocessor, while the cache is stocked with bytes from the host's slow 8-MHz memory banks.

Some manufacturers have reservations about memory caching, seeing it as a Band-Aid solution that works for some software but may have significant drawbacks in future applications.

"Caching is a very usable technique. It's very good as long as you can keep your code or data segments residing in the cache," notes Dell Computer's Lunsford. "But once we move into the OS/2 environment where a microprocessor must handle multiple concurrent processes, a problem called thrashing can arise. Every time the chip needs code for a different process, it will have to reload the cache. Moving code back and forth like that will impede performance."

Others are more reserved in their opinions.

"Caching is a standard architectural approach to all the minicomputers, which are almost always used in multiuser, multitasking applications. It's a well-accepted approach," counters John Patterson, senior vice president, Tandy Computer, Fort Worth. "The honest truth is than nobody knows what will happen with OS/2. Although we have the code, we don't have any applications. Nobody knows what will speed it up or slow it down."

Problems can arise with memory caches. For instance, a program may alter bytes in main memory that have also been copied to the cache. If the cache is not updated, then using its unchanged byte can result in errors.

Compaq uses a new support chip for the 80386 microprocessor called the 82385 cache controller.

"The 82385 helps us to achieve data coherency and high data integrity. The chip prevents the cache memory and main memory from ever getting out of sync," says Stimac. The 82385 has "snooping" capability, he explains. It can determine whether bytes in the main memory of the system are changed, for instance, when a hard disk is read. The 82385 ensures that those changes made in main memory aren't missed when the bytes from the same location are drawn from the cache.

In addition, the 82385 has the capability to buffer memory writes as well as reads. Consequently, the system can write to RAM with zero wait states. The 82385 then transfers the changed bytes to the main memory of the system. According to Stimac, caching memory writes can improve overall system performance by about 10 percent.

WEAVING MEMORIES A different technique breaks the whole memory of a computer system into a number of individual sections that each operate as a small cache. Implementing this technique requires special RAM chips that can divide their address range into a page or a group of rows and columns. These special chips allow very fast access in one of the two di-

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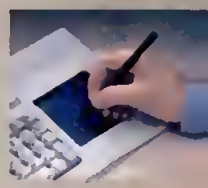

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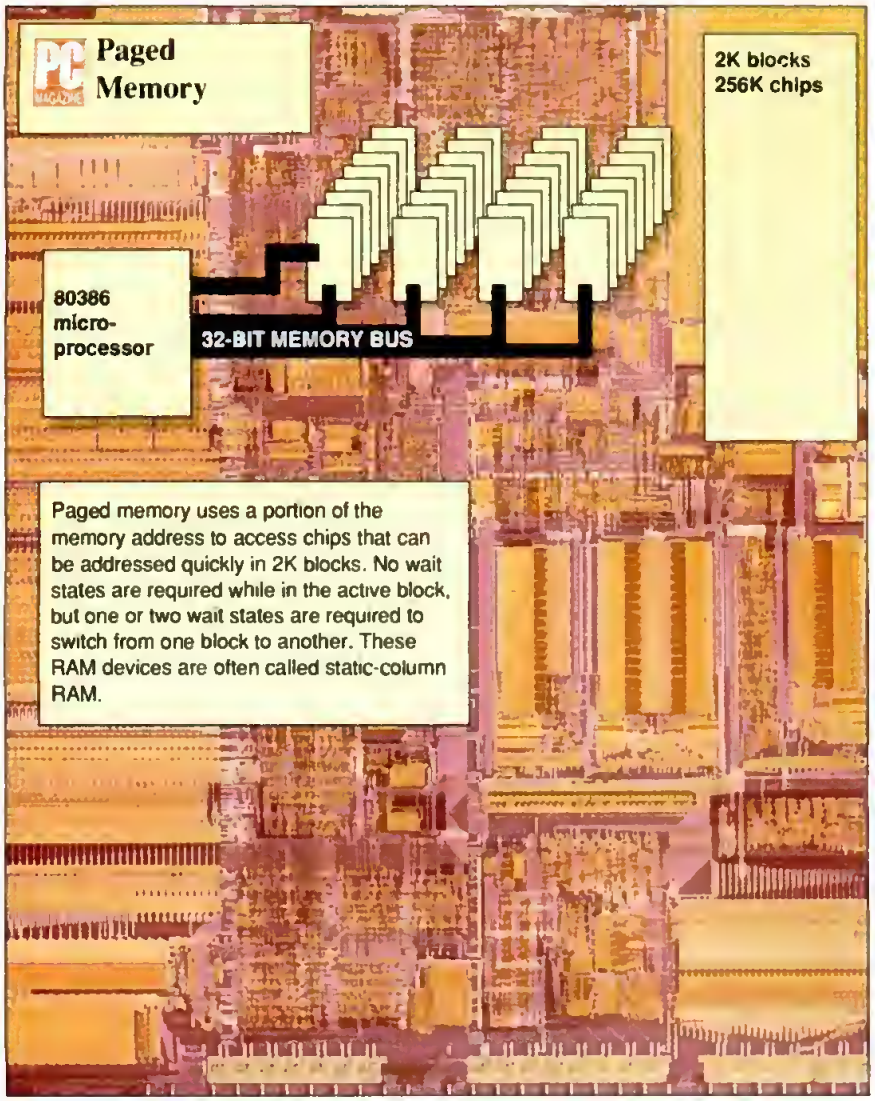

rections of their organization. Called page-mode access, this technique cuts the number of wait states in much the same way that a cache does.

"Essentially, page-mode access is a function of the type of RAM chips you use," explains James D. Rogers, product manager, Monolithic Systems Corp., Englewood, Colorado. "Once you access any location within a page, any other location in that page is accessible with no wait states. When you cross that boundary, you encounter wait states."

The special chips are called static-column or page-mode RAM. Although the two terms describe distinct chip technologies, in PCs their application is the same.

In the static-column RAM arrangement, sequential memory bytes are organized in adjacent rows within a single column. As long as the microprocessor attempts to access sequential memory bytes, it can retrieve information without wait states. When it dashes across columns for the information it needs, however, the microprocessor will require wait states to allow the memory to keep up.

Page-mode memory arranges memory in individual pages and allows back-to-back accesses made within a given page at zero wait states. Jumps outside the page impose wait states.

As with true caching, the performance of static-column or page-mode memory systems depends on the page or column size that makes up the individual "cache." The larger the cache, the higher the hit ratio and the better the performance. The static-column RAM of the Compaq Deskpro 386/16, for example, cuts the system from two wait states to about 0.8.

Another clever technique called "interleaved memory" also earns speed gains on sequential accesses but is not limited to a small page. In an interleaved memory system, the RAM is divided into two or more banks, and the microprocessor alternates between banks when it reads sequential bytes.

Typically, memory will be divided into two banks, and for sequential bytes the microprocessor will first read from one, then from the other, then again from the first. While one bank is being read, the other has time to refresh itself. As long as the microprocessor reads sequential bytes, it will encounter no wait states.

When bytes are not sequential, the microprocessor has a 50-50 chance of reading from the bank that is ready. Otherwise, the microprocessor will encounter one or more wait states while the requested bank is refreshed. Because of this, there's a 50 percent chance of making a hit with no sequential bytes. A four-way interleave can reduce wait states by 75 percent. In addition, interleaving is often combined with page-mode addressing to further improve performance.

Of course, the only way to eliminate wait states is to use memory that's fast enough to keep up with the microprocessor. In terms of practical microcircuits today, that means using SRAMs or very fast DRAMs for all system memory. Although it is the most expensive alternative, when performance counts, it's also the best.

COPROCESSOR CHOICE As an extension of the 80286 microprocessor, the 80386 is designed to work with all of its predecessor's software and hardware. Also included in its compatibility is the ability to make use of the 80287 numeric coprocessor.

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multiply floating-point numbers very quickly, hundreds of times faster than a general-purpose microprocessor like the 80386—and with much greater accuracy.

Because the 80287 is a separate microprocessor, it takes its own special program code to run. Thus, software must be specially written to use the 80287. It offers no benefit to programs that are not written to accommodate its needs.

Many 80386-based PCs include sockets for installing an 80287. In many cases, just any 80287 won't do. The chip comes in various speed ratings, from 4 to 12 MHz. Some systems only support particular speeds. Obviously, the faster the 80287 operates, the better the performance it will deliver.

Better than the 80287 is the numeric coprocessor designed as a companion to the 80386, the 80387. Not only is the 80387 capable of operating at the full microprocessor speed of the 80386 (both chips come in speed ratings from 12.5 to 20 MHz), but also its design is much improved over the 80287. In fact, it's so much improved that it can deliver performance four times better than an 80287. The 80387 is code-compatible with the 80287 and will operate with any software that supports the earlier chip.

But the 80387 is not the ultimate in numeric coprocessors. Another new chip called the Weitek coprocessor has been developed for the dedicated workstations that are used in computer-aided engineering (CAE). Compaq has adapted the Weitek coprocessor to some of the machines in its line of 80386-based PCs.

"The Weitek chip uses memory-mapped architecture and is a lot faster than the 80387 chip. Compared to the 80387, it's about ten times faster at the micro level," says Stimac.

The Weitek coprocessor achieves its high performance with a design completely different from that of the 80287 and 80387. Consequently, it requires its own special software. "The Weitek coprocessor is not compatible with code written for the 80287," notes Stimac. "But Compaq has worked with different compiler manufacturers, who are in turn working with people like Autodesk, so that they can recompile their programs to support the Weitek coprocessor. In the near future you will get very tremendous performance improvement in CAD applications," he says.

COMPATIBILITY CONCERNS In the early days of PCs, the term "compatibility" mostly indicated whether the computer in question could run Microsoft's *Flight Simulator*, a troublesome program that took direct hardware control of several system functions. Today, a more suitable concern might appear to be whether a specific machine will run *Lotus 1-2-3*—or whatever program you will rely upon for the majority of your daily livelihood.

The BIOS alone is not enough to free 386s from compatibility problems. Many systems stumble with nontraditional software.

With the advent of proven, independently written (from IBM) BIOS codes, many of the old compatibility concerns have been put to rest. BIOS routines (the initials stand for Basic Input/Output System) link software to the hardware of the computer, matching the hardware-specific port addresses through which many system features are addressed with simple firmware-coded utility routines.

When a program wants to read a character from the keyboard, for instance, it may call a BIOS function that queries the proper input port, reads the character, and resets the port for the next character input. The software never needs to know exactly where the character came from, so it can be written without regard to the system on which it will run.

Phoenix Technologies is credited with creating the first BIOS that achieved excellent IBM compatibility and was available to the general market of manufacturers. Using the Phoenix code, a company had a quick way of making its hardware truly compatible. Its availability is one of the cornerstones of the compatible computer industry.

Several newer BIOS systems have become available in the last couple of years, most importantly from Award Software and AMI, which have quickly earned reputations for compatibility with IBM chips. Because of these BIOS chip sets, this level of compatibility is almost a nonissue among 80386-based PCs.

But the BIOS alone is not enough to free 80386-based systems from compatibility problems. Many systems stumble with nontraditional software. Some hardware enhancements won't work with some 80386-based PCs. And specific 80386-based machines themselves are generally incompatible with the memory-expansion options of other 80386-based PCs.

The newly discovered software troubles concern the use of specific 80386 features never before present in personal computers. With no guiding standard, manufacturers have implemented features and interfaces in their own styles. As a result, some software that reaches down to 80386 hardware may work with one system and not with others.

The issue of hardware compatibility has two sides: the ability to make use of internal accessories developed for earlier-generation PCs, and the ability to interchange 32-bit expansion options with other 80386-based computers.

All 80386-based personal computers, with the exception of the IBM PS/2 Model 80, incorporate 8- and 16-bit internal bus structures generally compatible with those used by IBM's PC-XT and PC AT lines of personal computers. Although they don't have to be that way, this compatibility enables them to make use of off-the-shelf expansion cards such as disk controllers, video adapters, and memory boards. This degree of compatibility gives both you and the system manufacturer the surest way to low-cost system expansion and access to the widest possible array of options.

To accommodate such expansion, most 80386-based computers operate their internal expansion buses at less than the clock speed of their microprocessors, 8

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MHz (for compatibility with AT expansion options) being the preferred performance level.

The lower speed is necessary because most expansion cards won't operate much faster than 10 or 12 MHz. Of course, this lower bus speed means that accessing any expansion cards will reduce system throughput, sometimes severely.

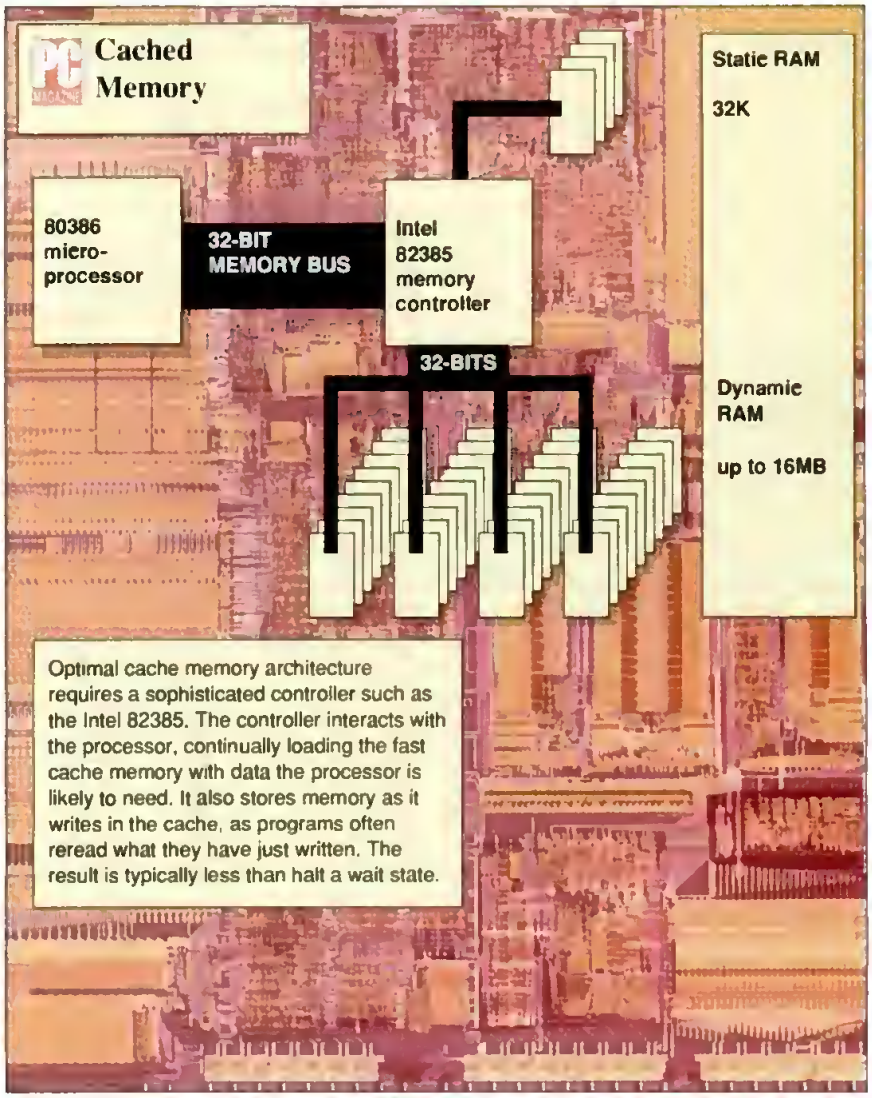
To wring more performance out of of their systems, some manufacturers allow you the option of running the expansion buses of their machines at higher speed. For example, the PC's Limited 386-16 jazzes up bus speed to 12 MHz on demand, selected through the system setup procedure. Some expansion products may not operate at this rate.

Other, more subtle incompatibilities may arise. For instance, the PC's Limited 286 series of computers uses a memory bus structure that varies slightly from that of the IBM's PC AT. Some third-party memory expansion cards won't work in those machines. Similar problems may arise with other manufacturers' computers and expansion products as well.

More vexing is the lack of consensus for 32-bit expansion of 80386-based computers. Without a doubt, full 32-bit expansion is the only way to achieve top performance with add-in products for these machines. But a lack of standardization has prevented the influx of 32-bit-based boards.

One facet of the problem is purely physical. Different manufacturers locate the additional connections for the extra 16 lines of the data path in different places. Some, notably Intel, extend the connectors of the standard AT bus to accommodate a full 32 data bits. Others add extra connectors at various places on the system board that solely accommodate memory expansion. The former technique, while providing for more memory, also permits the possibility of adding other 32-bit components, for instance, a wide-bus hard disk controller.

Intel adopted this strategy for its AT-compatible iSBC-386AT OEM system board, which is used by more than half a dozen machine manufacturers. The popularity of this board has lead to its acceptance as a de facto standard of sorts for 32-bit expansion, with at least one non-Intel board using the same structure for its wide bus slots.



The expansion slot architecture is dependent on the underlying structure of the host computer's memory bus. Thus, it is unlikely that systems using different memory technique can share memory expansion boards. Products with four-way interleaving would not work with systems that have two-way interleaves. Dynamic memory boards won't work in static RAM systems. Caching systems, however, hold the potential of working with other techniques, depending on their underlying structure.

Bus architecture can affect performance as well as expansion. Two examples are IBM's Micro Channel and Compaq's Flex Architecture. Both systems allow, in their own ways, information to be shifted differently—in particular, faster—than in earlier PCs.

Because IBM is treading new ground with the Micro Channel, it need not abide by traditional standards or worry about hardware incompatibilities. Consequently, the Micro Channel runs faster and more intelligently. For instance, the PS/2 Model 50 is able to transfer information from hard disk nearly twice as fast as an AT despite having a clock speed which is only 20 percent faster.

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■ 80386-BASED PCs

Compaq retains PC compatibility on its bus but splits it into two parts, one side for memory and one side for system I/O. The two sides can operate independently and concurrently, and each can be optimized for its own particular purpose. On hard disk operations, the Compaq architecture is nearly as fast as the Micro Channel, even though it operates at a lower clock speed.

MASS STORAGE Nearly all 80386-based computers come with some sort of high-speed mass-storage system. After all, the supercharged performance of an 80386-based PC would be hardly worthwhile if you have to spend 90 percent of your time shuffling floppies and waiting for programs to load.

At one time, nearly everyone lumped all hard disks together. They were simply better and faster than floppies. The AT changed the hard disk perspective by putting increased emphasis on average access time, the speed at which the hard disk could locate any given byte in its memory domain. All disks were classed as either AT-specification (with an average access time of 40 milliseconds and quicker) or cheap stuff (more laggardly drives).

While a swift disk with a low average access time is of even more importance for 80386-based PCs (the quicker the better—speeds under 28 ms. are the most desirable, and 16-ms. drives are available), another figure of hard disk merit also demands attention: the data transfer rate. This specification indicates how quickly the processor can shift blocks of data from magnetic memory into system RAM.

Use of 80386 technology makes data transfer rate important because computers can, for the first time, deal with data that moves faster than bytes can be peeled off the conventional hard disk. Although the 5-MHz data transfer rate of the traditional hard disk seems fast enough, PCs and XTs were not capable of dealing with information at that rate. Even ATs could not accommodate it quickly enough. Hence the actual throughput of a mass-storage system, the speed at which data could actually be put in memory and used, lagged far behind the rated 5 MHz.

Computers based on the 80386 microprocessor are more than fast enough to accept information at the peak rate at which standard hard disks can deliver it. At the same time, 80386-based PCs tend to work on bigger, more complex problems involving larger numbers and bigger blocks of data. The new machines demand faster and more efficient mass-storage handling to facilitate the type of high-volume work they will be doing.

Several techniques have been used for improving hard disk data transfer performance. One impediment to better performance is the data channel barrier. All PCs based on the original IBM design have severe design weaknesses in moving information from disk to memory, which is the primary limit on throughput. All computers designed to be compatible with the original PC are inherently handicapped by this architecture.

The Micro Channel architecture of the IBM PS/2 Model 80 avoids this encumbrance by starting with a clean design slate, totally redefining the bus structure. It's effective enough to more than double the throughput of PS/2 systems compared with those based on PC architecture, all else being equal.

Another technique used for boosting data transfer speed is to speed up the disk itself by using a different disk-to-computer interface. Both the SCSI (Small Computer System Interface) and ESDI (Enhanced Small Device Interface) offer faster data transfer speeds than the 5 MHz of the conventional connection—speeds that the 80386 microprocessor can put to use. Consequently, manufacturers are adding these newer disk interfaces to their products. IBM, Compaq, and PC's Limited offer systems with ESDI-interfaced hard disks, while Zeos International has built an SCSI interface into its 386 replacement motherboard.

No single feature is enough to make one 80386-based computer better than another. As with vintage wines, a truly great PC is a combination of elements that must work together. It must have balance, with no one factor dominating.

Indeed, today's 80386-based PCs show great promise, and they may just have achieved an early—and an excellent—maturity.

Winn L. Rosch is a contributing editor of PC Magazine.

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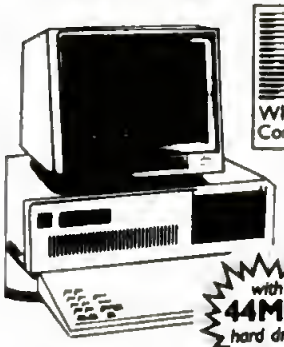

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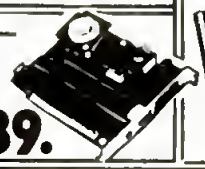

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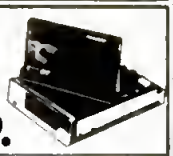

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TRADING UP TO A 386

Replacement 80386-based system boards will boost the power and performance of any compatible.

You've probably seen enough dire warnings about the dangers of static electricity to computer components to be wary even of peeking inside your system unit, let alone replacing your whole motherboard with a 386 system board. Contrary to what you may think, the surgery is simple, the dangers few, and the results will be astounding.

The advantages won in updating either an XT or AT to an 80386 microprocessor are overwhelming. The result is a computer that's better and more powerful than anything you've had before. For ATs, it means a twofold performance improvement; for PCs and XTs, almost twentyfold.

Moreover, system board replacement is one sure way of overcoming the handicap of a dead-end microprocessor, one incapable of handling the latest software technologies such as the multitasking of DOS programs. Compared with the cost of a new 80386-based PC, updating your existing machine with a new system board will save you hundreds, perhaps thousands, of dollars. And the update gives you something to do with a computer that today seems more suited to holding papers down or doors open than processing data.

System board replacement is a more integrated solution than simply sticking a 386 turbo board into your XT or AT. Although more expensive than an add-in turbo, the system board delivers smoother operation, particularly of the video and input/output (disk) subsystems. The differences in installation time and difficulty are insignificant. System boards are no more delicate than other add-in boards. If you can handle a video adapter, you won't have trouble installing a new motherboard.

The bigger risk is compatibility. Once you've replaced the IBM system board in your PC, XT, or AT, you will have lost the valuable IBM BIOS (Basic Input/Output System) contained in the on-board ROM. By definition, the IBM BIOS is the most IBM-compatible BIOS available. The new

system board will include its own BIOS, one guaranteed to have non-IBM origins. A slight chance exists that some software may not work with a non-IBM BIOS.

At minimum, you'll lose compatibility with the BASIC interpreters included with PC-DOS. You'll have to get a generic version of Microsoft BASIC, such as GW-BASIC, to run whatever interpreted BASIC programs you already have.

Most replacement system boards come complete with a set of the very compatible BIOS chips made by companies like Phoenix Technologies, Award Software, and American Megatrends International. With these, you're unlikely to encounter difficulties running any major commercial application.

Admittedly, 80386-based system boards are still expensive, possibly worth more than the current value of the machine you're going to slide them into. An 80386 microprocessor alone can cost you $300 to $400, the price of an entire 80286-based system board by mail order. But for anyone who needs top performance and the key to tomorrow's software technology, the cost-benefit analysis of a system board transplant rules strongly in favor of sliding in an 80386-based system board.

FITTING ROOM The biggest problem you'll face in installing a new system board in your computer will be finding a board that will fit and work with the components you already have. While expansion boards have been standardized into one near-universal size for interchangeability, 80386-based replacement system boards are much more limited in the scope of their host compatibilities.

For instance, the fundamental difference between XT and AT system boards is easy to grasp. Hold one in your hand, and you'll see that the larger chassis of the AT is built around a larger system board. Consequently, replacement system boards must be sized to fit inside the cases of different models of possible host personal computers. To make a successful system board transplant, you've first got to find a board that will fit into the chassis of your computer.

The differences don't end there. Although the system boards used by the IBM PC and PC-XT have the almost the same width and depth dimensions, for instance, they feature different numbers of expansion slots and different slot spacing. The PC has five expansion slots, each set 1 inch apart. The XT fits eight slots in an area only slightly larger by shrinking the spacing between boards to 0.8 inch.

Put a replacement board meant for one chassis into another, and the expansion slot connectors on the board won't line up with the retaining brackets on the chassis.

Much of the allure of replacing your system board is you can take advantage of expansion boards already in your computer.

A replacement system board meant for one system won't work in another—unless you don't care about expansion. Expansion boards—including such necessities as the display adapter and disk drive controller—just won't fit.

On the other hand, there are some surprising similarities among system boards. Some widely divergent computer designs use system boards of similar size. The relatively new XT Model 286 is an XT in size and shape but an AT in performance. Replacement 80386 system boards designed for the XT will fit into the XT Model 286 chassis, yet will still about double the performance of the 6-MHz, no-wait-state IBM original—in addition to endowing it with all the inherent multitasking features of the 80386 chip. (Other incompatibilities may daunt you, however, such as with the keyboard or hard disk controller.)

Matching an 80386-based replacement system board with a PC- or XT-compatible computer—as opposed to those bearing the official IBM label—is more perplexing. In general, the cheaper, non-name-brand clones are better candidates for such an upgrade because their original system boards are more likely to be exactly patterned after the IBM original. The design teams of major manufacturers of IBM-compatible computers are most likely to have wandered in their own, independent directions to make their products stand out from the rest of the market and gain a competitive edge. In particular, the smaller-footprint computers like the AT&T 6300, Tandy 1000, Epson Equity I, and Leading Edge Model D won't be compatible with standard replacement system boards designed for IBM hardware because IBM-size boards simply won't fit, and boards of the proper dimensions are not yet available.

The AT and its clones present a similar situation. Direct replacement system boards are available for the IBM PC AT, and these same products will fit many of the lesser-known clones that use chassis with the same mounting measurements as the IBM original. In addition, reduced-size 80386-based replacement system boards are becoming available to fit the AT chassis as well as many of the the smaller-footprint chassis used by many clones.

Most AT compatibles as well as XT-based machines use the same slot spacing—0.8 inch—so if you can get a board into the machine, you can usually make it work if you're willing to be clever with the mounting hardware. For instance, a replacement system board with entirely different mounting-hole spacing can be installed in a chassis by inserting a hold-down screw (and spacer to keep the board at the proper height from the bottom of the chassis) in each mounting hole in place of the standard mounting hardware.

POWERFUL PROBLEMS Size isn't the only consideration when you want to install a new system board inside a non-IBM host chassis. While most replacement system boards use IBM-standard power connectors, the system boards of some compatible computers use a different wiring scheme. As a result, you may not be able to plug the power supply of a non-IBM computer into a standard replacement system board. Compounding the problem, you're unlikely to be able to buy connectors to match your loosely compatible computer power supply to a new system

386 Replacement Boards: Summary of Features

(Products listed in ascending price order)

	Zaos 386 Motherboard $1,395	Haappaaga 386 MotherBoard $1,495	Dyna SX386 $1,650	Intel iSBC 386AT $1,995	Monolithic Microframe 386 $3,295
Speed	16/20 MHz	20 MHz	16/20 MHz	16 MHz	16/20 MHz
PC, XT, AT compatible	AT	PC, XT	XT, AT (with modification)	AT	AT
BIOS type	Phoenix Technology or Award Software	Award Software	American Megatrends International	Phoenix Technology	American Megatrends International
On-board memory	2MB	1MB	2MB	512K	2MB
Maximum memory	16MB	16MB	2MB	16MB	8MB
32-bit expansion	●	●	○	●	○
Number of slots	8	8	8	8	8
Coprocessors supported	80287, 80387	80287, 80387	80287, 80387 (requires adapter for 387)	80287, 80387	80287, 80387
Keyboard compatibility	AT	XT	XT (AT optional)	AT	AT
XT/AT connection facilities	Keyboard, speaker, reset, keylock, power on, floppy-disk port	Keyboard lock, power on, speaker	Speaker, keylock, power on	Keyboard	Keyboard, keylock, speaker, running LED

—Indicates Editor's Choice ●—Yes ○—No

board. Such connectors can be hard to get, particularly in small quantities.

Upgrading an ordinary IBM PC to 80386 status poses another power problem. The PC's 63.5-watt power supply probably won't be sufficient to operate a full-fledged 80386-based computer system, which may draw more than half of its potential. Besides the system board itself, you'll have to upgrade to about 135 to 150 watts to make the new system run reliably. You should be able to find a Taiwan-made 150-watt power supply for under $50 through the direct-mail retail channel.

KEY DIFFERENCES Another difficulty that may not be discovered until too late is the keyboard. You'll probably want to use your old keyboard with your new system board, but they might prove incompatible. IBM has offered three different keyboards for various models of PCs, and while they all use the same connector, they are not completely interchangeable. In addition, your supposedly PC-compatible computers may or may not have keyboards that are plug-compatible with the IBM designs. Before you buy any replacement system board, make sure the keyboard you have will be compatible with it.

A mismatched keyboard is not an insurmountable obstacle, however. Keyboards that follow the interfacing scheme of the original PC and original AT standards are available by mail order for about $50 to $100. Although the subjective "feel" of a new keyboard may not match that of your old one, at least it will help you put your system to work again.

SHUFFLING CARDS Much of the allure of replacing your system board is that you can take advantage of the expansion boards already inside your computer. In particular, you'll want to use your display adapter, communication ports, and disk drive controller with your new system board. Although most replacement system boards are designed to operate with existing PC peripherals, that's not always true—nor is it always desirable.

As a general rule, most replacement system boards follow the AT standard for their 8- and 16-bit expansion areas. Along with the standardized connectors, replacement boards usually deliver an 8-MHz clock rate to the expansion bus. While most PC and XT plug-in boards function fine under such conditions, you may encounter problems with some adapters. In particular, the IBM asynchronous communications adapter—standard equipment with early models of the XT and optional for PCs—may fail at this speed. You'll need to upgrade to a faster communications adapter when you upgrade your system board.

In some cases it's a good idea to upgrade other parts of your computer when you install a 386 motherboard. Although replacement-style system boards for PCs and XTs will work with hard disk controllers that use an 8-bit bus interface (such as the Xebec board commonly installed in XTs), such an old-fashioned controller is hardly a desirable companion for an 80386-based computer. The narrow 8-bit data path slows information transfers with

the hard disk drive by 50 percent.

If you're spending $1,500 or so on a system board, you won't want to be held back by a laggardly hard disk. Upgrading to a 16-bit-interface, high-performance AT-style combined hard-and-floppy-disk controller will not only save you expansion space (you can replace two expansion cards with one) but will nearly double the data transfer speed of your disk drive. The cost is not burdensome—such controllers are available for as little as $120 from mail-order suppliers.

Alas, an AT-style controller may not work with the replacement system board that you choose. The system board must explicitly support an AT-style disk controller board for the transplant to be successful. All of the boards that are reviewed here will support an AT-style controller, however.

The SX386 is designed for XT upgrades, but can also be installed in a mini-AT chassis without modification.

Beware, too, that many AT-style disk controllers may be physically incompatible with PC- and XT-size computers. The AT expansion board specification allows nearly an inch more height than the PC standard because of the larger size of the AT case. If the controller takes full advantage of the space available inside an AT, it won't fit in your upgraded PC or XT. Certainly, the board will slide into a full-length 16-bit expansion slot, but then you won't be able to put the lid back on your computer.

If you find the idea of upgrading your current computer to a machine second to none on the market today intriguing, you'll be delighted to know that many board makers have found it intriguing likewise. With some 10-million-plus personal computers equipped with 8088 and 80286 microprocessors sitting on desks across the country, they see a huge market for replacement system boards. As a result, an ever-increasing number of products are being developed. Already you have a broad selection of boards to choose from, and more are slated for release soon. The following is a look at replacement boards currently on the market.

DYNA COMPUTER INC.

Dyna SX386

Pop out your old XT system board, plug in Dyna Computer's SX386, and performance will improve by nearly 2,000 percent. The proposition is tantalizing, and the $1,650 board really delivers on its promise with a 16- or 20-MHz 80386, two coprocessor options, advanced memory, and programmable performance.

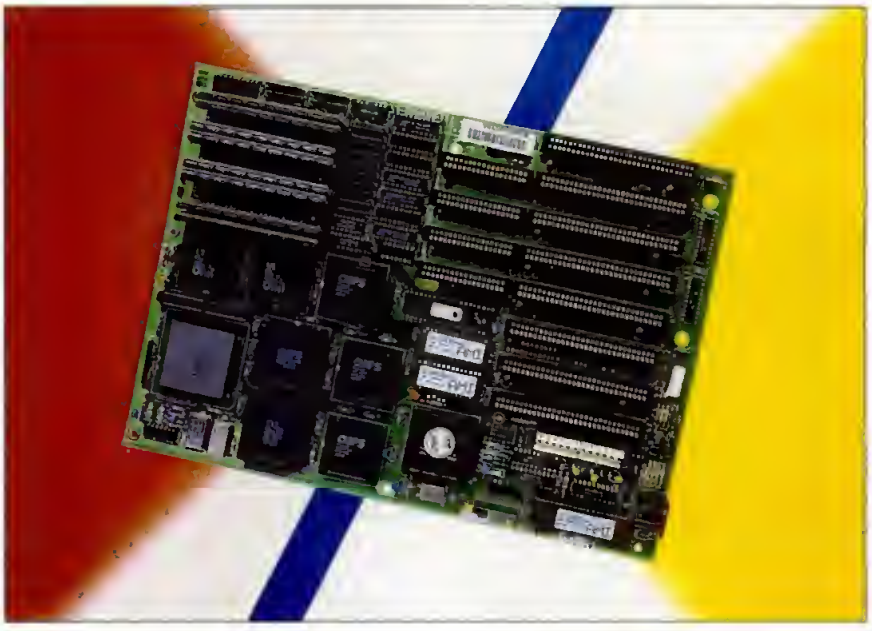
The difference in speeds amounts to nothing more than the chips plugged into the board. Twenty-megahertz performance requires a faster 80386 and a set of eight quicker Chips and Technologies VLSI circuits upon which the SX386 is based (incidentally boosting the price of the board to $2,500). A jumper on the ½-by 12-inch SX386 board sets the speed. Crystal-determined, the speed choice is optional: you name the speed you want when you order the board, up to the limits of available 80287 chips.

A better choice is to add a faster 80387 coprocessor. Although no socket is provided for this chip, the 80387 can be installed with an adapter board that inserts between the main 80386 microprocessor and its socket.

The six-layer SX386 system board incorporates eight expansion connectors at the requisite XT/AT 0.8-inch spacing. Four (five by special order) use the AT-style 16-bit bus, four, the 8-bit XT data path. No 32-bit bus expansion is available. The two short slots imposed by XT chassis construction are equipped with 8-bit connectors.

The expansion bus operates at either 8 (the default) or 6 MHz. By substituting a higher-speed timer module (combined crystal and oscillator in a can), bus speed can be increased to 10 MHz. You'll want to specify speeds when ordering the SX386 because all timers/crystals are soldered to the board.

Standard memory of the SX386 is 2MB, consisting of eight 256K SIP (Single In-Line Pin) page-mode memory modules rated at 100 nanoseconds. To cut the



Dyna Computer's SX386 board brings 16- or 20-MHz 80386 power to XTs, and can also be installed in ATs with only minor modifications to the mounting hardware.

Photographs: Roberto Brosan

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number of wait states, the memory is operated with 4K pages (2K per bank) and a two-way interleave.

The page-mode memory eliminates wait states when sequential memory accesses are within the bank. The two-way interleave cuts the probability of encountering a wait state outside of a page by one-half. The exact number of wait states imposed by the system is configurable using setup software which is supplied by Dyna Computer.

The first megabyte of system RAM is split, with 640K devoted to DOS and the balance to shadow RAM that enables all ROM code to execute in fast, 32-bit memory. All other memory is addressed in the extended area.

The memory is located at the left front of the SX386 board, directly in-line with the gaps between five of the expansion connectors. The SIPs stick up about 1 inch from the board and may interfere with components on some long expansion boards, although they won't interfere with the board substrate itself. One 16-bit slot is not obstructed in any way.

The 16-bit ROM, which is remapped to 32-bit shadow RAM during operation, contains a BIOS written by American Megatrends International. The keyboard ROM chip also bears an American Megatrends copyright. Although the SX386 is designed for XT upgrades, the standard keyboard chip accepts AT-style keyboards. XT keyboard compatibility is optional.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Dyna SX386
Dyna Computer Inc.
3081 N. First St.
San Jose, CA 95134
(408) 943-0100
List Price: $1,650
Requires: XT or AT chassis.
In Short: Designed for XT upgrades, the Dyna board can also be installed in a mini-AT chassis without modification, and in AT boxes with some modification to the mounting hardware. The board offers good performance (your choice of 16- or 20-MHz clock speed) and is reasonably priced.

CIRCLE 678 ON READER SERVICE CARD

According to Dyna Computer, the SX386 can also be installed in a mini-AT chassis without modification. It also easily fits within a standard AT case but will require some modification of the mounting hardware.

The SX386 board incorporates all AT features and connection facilities. Its time-of-day clock and CMOS configuration memory are powered by an external 6-volt battery source (four AA batteries recommended), connected through a 4-pin header near the keyboard connector.

Near the front of the board are a 4-pin speaker connector, 5-pin keyboard lock connector, and a 2-pin reset button. The only mandatory hardware adjustment on the board is a single jumper that selects color or monochrome/EGA monitor use.

The board works well, its speed limited mostly by the microprocessor. Its makers claim it will work at 24 or even 32 MHz when such chips become available. The board's biggest flaw is that the location of its memory chip might interfere with some long expansion boards. If you can live with that, you'll love the SX386.

HAUPPAUGE COMPUTER WORKS INC.

Hauppauge 386 MotherBoard

While the name Hauppauge may be unpronounceable by anyone outside of the Long Island community that shares the moniker, ordering Hauppauge Computer Works' 386 MotherBoard may be worth the elocutionary effort. A product of the design efforts of some renegade ex-Intel engineers, the $1,495 MotherBoard is designed to replace the original IBM XT system board and, at 8½ by 12 inches, is slightly more compact than the original.

The board is built around a combination of five Chips and Technologies VLSI circuits and a number of custom PAL (Programmable Array Logic) chips. Conforming perfectly with the XT layout, it includes eight expansion slots at 0.8-inch increments. Two slots use the 16-bit AT bus structure, five the standard XT bus, and one is equipped for proprietary 32-bit expansion. The two slots that are shortchanged for space in a standard XT chassis are both 8-bit.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Hauppauge 386 MotherBoard
Hauppauge Computer Works Inc.
358 Veterans Memorial Hwy.
Commack, NY 11725
(516) 360-3827
List Price: $1,495
Requires: PC or XT chassis.
In Short: The Hauppauge board delivers the best price-performance ratio of any XT upgrade. It works smoothly and reliably and makes the transition to state-of-the-art computing painless.

CIRCLE 677 ON READER SERVICE CARD

Another, similar board is available from Hauppauge for sliding into PCs. It's equipped with five slots at 1-inch increments: two 8-bit, two 16-bit, and one proprietary 32-bit.

The PC adaptation poses an additional problem in that the MotherBoard consumes 30 to 35 watts, an intolerable strain on the 63.5-watt standard equipment power supplies in those machines. Hauppauge recommends a minimum of 135 watts to run a system equipped with the board.

All expansion slots—except for those on the 32-bit bus—in both styles of MotherBoard operate at 8 MHz. The MotherBoard's 80386 microprocessor and the 32-bit slots run at a full 16 MHz and use four-way interleaved memory, yielding no-wait-state operation about 75 percent of the time. A socket is available for an 80387 numeric coprocessor.

The MotherBoard's standard 1MB memory endowment, soldered to the system board, comprises 36 dynamic RAM (DRAM) 100-nanosecond chips with 4- by 64-kilobit architecture and a 100-ns. speed rating. Memory is logically split, with 640K devoted to DOS, 64K to shadow memory for making the Award Software BIOS routines run in fast 32-bit RAM, and the rest to the extended memory area. Expansion memory boards are available from Hauppauge with capacities of 4MB ($495 with 1MB installed) and 12MB (price as yet undetermined). Expansion memory is also four-way interleaved.

The keyboard chip also bears an Award Software copyright and is designed for use with the standard XT keyboard.

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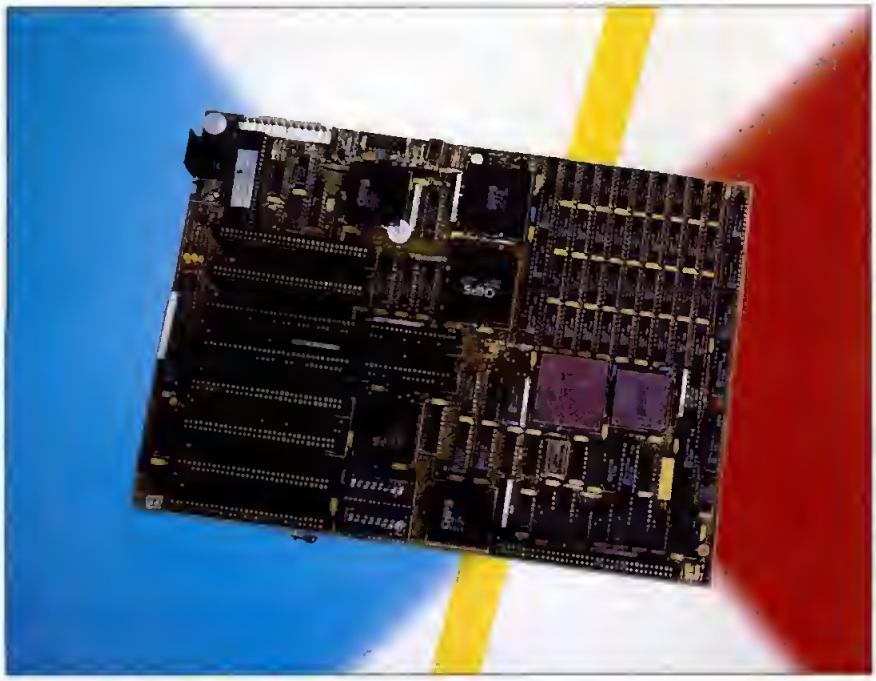
CIRCLE 734 ON READER SERVICE CARD



Hauppauge Computer's $1,495 MotherBoard is designed to replace the IBM PC-XT system board. At 8½ by 12 inches, it is more compact than the others, and it works smoothly and reliably.

In that the MotherBoard is designed primarily for direct replacement, only those connections required in an XT (or PC) are provided at the front of the board: IBM-style, rectangular-pinned power connectors (properly keyed) and a 4-pin speaker connector.

Although physically XT-compatible, the MotherBoard more closely follows the AT design. Built into its circuitry are CMOS configuration memory and a continuously running clock. A connector is provided for attaching an external battery supply. Unexpectedly, Hauppauge includes the batteries—three AAs—as well as a holder with a sticky tab for mounting on any convenient surface.

Most ordinary PC and XT peripherals—including hard-and-floppy-disk controllers, display adapters, and communications cards—work with 386 MotherBoards because the expansion bus runs at a relatively modest 8 MHz. The high-speed 80386 processor makes the ordinary XT hard disk and its 8-bit controller seem to drag however, so Hauppauge allows you to upgrade to an AT-style controller and high-performance disk.

The Hauppauge board's subjective feel improves on its already impressive specifications. It delivers the best price-performance ratio of any XT upgrade.

The Hauppauge board has a subjective feel that improves on its already impressive specifications. It works smoothly and reliably, and makes the transition to state-of-the-art computing painless. Although faster boards are becoming available, the Hauppauge delivers the best price-performance ratio of any XT upgrade. That should be enough to recommend it.

INTEL CORP.

Intel iSBC 386AT

Not suprisingly, the $1,995 Intel Corp. iSBC 386AT was the first 80386-based system board available. Its designers had, perhaps, a bit of inside information on what was required to put its 16-MHz 80386 microprocessor to work. What they created was a full-size AT-like system board with decidedly non-AT performance, able to carry out most tasks at a double-time rate.

Current models of the iSBC 386AT motherboard (at writing, it's in its sixth revision) take full advantage of the 80387 numeric coprocessor as an option. Alternatively, an 80287 on a special adapter board can be plugged into the 80387 socket to deliver somewhat more modest performance.

Every square inch of the big (13½- by 12-inch) board is put to use as residence for the huge array of logic chips—over 150 of them. One large block of that space is devoted to the board's base endowment of 512K of memory, 16 4- by 64-kilobit DRAM chips rated at a 120 nanoseconds, all soldered down. Logically this memory is configured into two interleaved banks, which cuts the effect of the two wait states imposed by DRAM chips in half, giving the board a one-wait-state rating.

Additional memory must be added through the two 32-bit expansion slots of the iSBC 286AT. Intel offers boards that add 2MB or 8MB (each) to the endowment of the system board, also two-way interleaved.

One element of the memory design of

PC MAGAZINE FACT FILE

Intel iSBC 386AT
Intel Corp.
5200 NE Elam Young Pkwy.
Hillsboro, OR 97124
(501) 696-7399
List Price: Priced by quantity.
Requires: AT chassis.
In Short: The first replacement 386 motherboard shows its age. Though competent, there are faster and better boards available for upgrading your AT.

CIRCLE 678 ON READER SERVICE CARD

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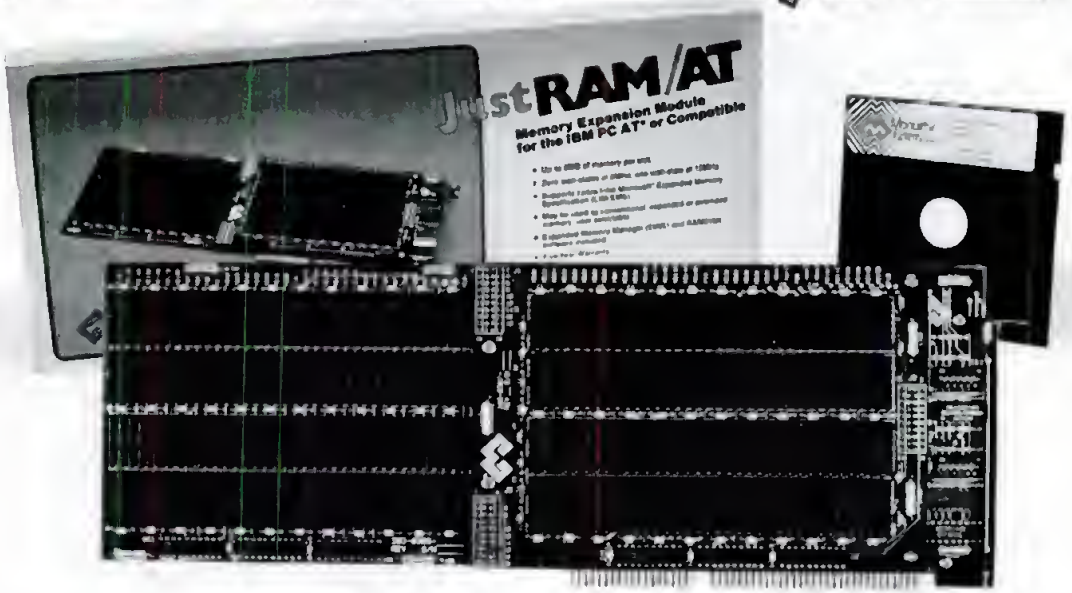

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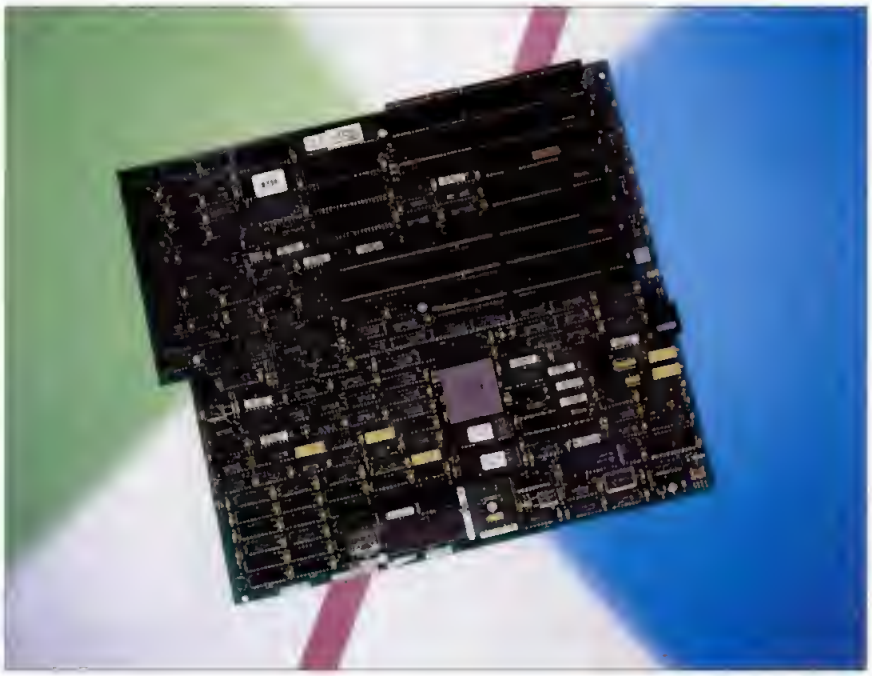

Intel's iSBC 386AT was the first replacement 386 motherboard. Current models take full advantage of the 80387 math coprocessor as an option.

the iSBC 386AT is probably its weakest feature, at least to DOS users. The only method for pushing DOS memory from 512K to the 640K limit that Intel supports is through the use of a 16-bit expansion board.

Expansion slots include four 16-bit and two 8-bit, all operating at 8 MHz and imposing additional wait states. The two 32-bit slots are also compatible with 8-bit expansion boards. Although they operate at 16 MHz with 32-bit boards, they default to 8 MHz when expansion boards with narrower interfaces are used.

The standard BIOS firmware, written by Phoenix Technology, includes a routine to simulate 8-MHz operation for compatibility purposes. The low speed is simulated by adding more wait states rather than knocking down the clock speed. Shifting between performance levels requires only pressing a keystroke combination: Ctrl-Alt-1 to go up, Ctrl-Alt-2 to go down. The system setup routines are not included in this ROM.

The keyboard chip is also a Phoenix product and is designed to accept standard AT keyboards.

Included in the iSBC 386AT circuitry is a serial port and a parallel port, both terminating as 26-pin headers that are located just in front of the keyboard connector. Jumpers on the board are used to set the former port as COM1 or COM2, the latter as LPT1 or LPT2, or defeat either of the ports entirely.

TIME OF DAY The system board includes both an AT-style time-of-day clock and CMOS configuration memory with support for almost 50 different hard disk configurations. Both features are jumper-defeatable. Battery power for the CMOS memory and clock—6 volts typically drawn from four AA cells—plugs into a connector similar to one of the standard IBM-style power input connectors on the iSBC 386AT.

Although the iSBC 386AT board is aimed at OEMs, it is available through mail-order suppliers and, perhaps, through dealers. While it does offer you an opportunity to upgrade your AT, new and better boards that take advantage of VLSI and other state-of-the-art technologies are now available.

MONOLITHIC SYSTEMS CORP.

Monolithic Microframe 386

An old name in big computers, Monolithic Systems Corp. has been around since 1969, emerging from the core memory industry to make some of the first solid-state silicon memory boards for mainframes. The company now has five divisions specializing in custom work, single-board computers, and minicomputer memory boards, as well as PC memory products.

As the name implies, the Microframe 386 board is designed around an Intel 80386 microprocessor and is available in versions that operate at 16 MHz ($2,345) or 20 MHz ($3,295). A socket is available for an 80387 numeric coprocessor, which further augments that board's performance.

For compatibility purposes, both the microprocessor and expansion bus speed can be reduced to 6 MHz by pressing a combination of keys at the keyboard.

Most of the circuitry of the eight-layer 8½- by 13-inch board (early boards were six-layer) is built from Chips and Technologies VLSI components—a total of eight square black chips. The BIOS, in 16-bit bus ROMs, bears an American Megatrends copyright, while the keyboard ROM is a product of Award Software, designed to use AT-style keyboards. A system setup program and diagnostics are held in ROM.

Laid out to fit the AT chassis, the Mi-

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Monolithic Microframe 386
Monolithic Systems Corp.
84 Inverness Circle East
Englewood, CO 80112
(800) 525-7661
(303) 790-7400
List Price: 16 MHz, $2,345; 20MHz, $3,295.
Requires: AT chassis.
In Short: Probably the best upgrade for existing ATs, the Microframe 386 offers excellent performance, no major, and few minor flaws. When the XT version becomes available, it will also rank among the best.

CIRCLE 675 ON READER SERVICE CARD

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EGA Complete System $1610

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Benchmark Tests: 386 Replacement Boards

While the NOP and 80386 Instruction Mix test results were appropriate for each board's processor speed, the 20-MHz advantage of the Dyna SX386 and the Monolithic Microframe 386 was wiped out by slower RAM access in our Conventionel Memory tests. The 16-MHz Hauppauge 386 MotherBoard and the 20-MHz Zeos 386 Motherboard, which have memory speeds comparable to that of the PS/2 Model 80, surpassed the rest. Results for the BIOS Disk Seek and DOS Disk Access benchmark tests were generaliy comparable to those of the AT but were not quite up to those of the Model 80 because of the Model 80's faster disk.

Excluding the disk and video tests, all of these boards will give you performance that is at least twice as good as that of an IBM PC AT. The 20-MHz Monolithic, Dyna, and Zeos system boards have the edge in processor-heevy operations and come out ahead overall, while the Hauppauge joins the Zeos in yieiding faster RAM speeds. It should be noted thet the Zeos board tested was e fine-tuned preproduction board end may not reflect fectory-shipped performance.

Each of the 386 replacement system boards was tested using a Seagete ST4038 AT-class hard disk and e standard IBM disk controller with a 16-bit data path. Ali the video tests were timed using a Color/Graphics Adapter except the PS/2 Model 80, which was tested using its built-in VGA.

Performance Times
(Times given in seconds except where noted)

	NOP	80386 Instruction Mix	Floating-Point Calculation	Conventional Memory	BIOS Disk Seek (milli-seconds)	DOS Disk Access (milli-seconds)	Video BIOS Routine Without Scrolling	Video BIOS Routine with Scrolling	Direct to Screen
4.77-MHz IBM PC-XT	10.1	32.0*	159.2	5.9	95.6	119.2	17.2	23.4	11.5
8-MHz IBM PC AT	4 2	9.0*	35.6	1.3	37.2	43.5	4 5	7.7	4.6
IBM PS/2 Model 80	2.1	4.4	15.6	0.6	33.6	32.6	0.9	3.7	6.6
Hauppauge 386 MotherBoard	2.1	4.1	15.1	0.6	37.0	41.8	1 4	7.4	6.7
Intel ISBC 386AT	2.1	4.6	17.3	0.7	37.4	42 5	7.0	11.5	5.6
Monolithic Microframe 386	1.7	3.7	15.2	0.6	36 8	41.7	6.2	9.0	5.6
Zeos 386 Motherboard	1.7	3.2	12.9	0.6	37.0	41.7	3.6	7.6	4.6
Dyna SX386	1.6	3.7	15.2	0.6	36.9	41.7	3.4	7.6	4.6

*The XT and AT were tested with the 8086 and 80286 Instruction Mix test versions, respectively

The **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

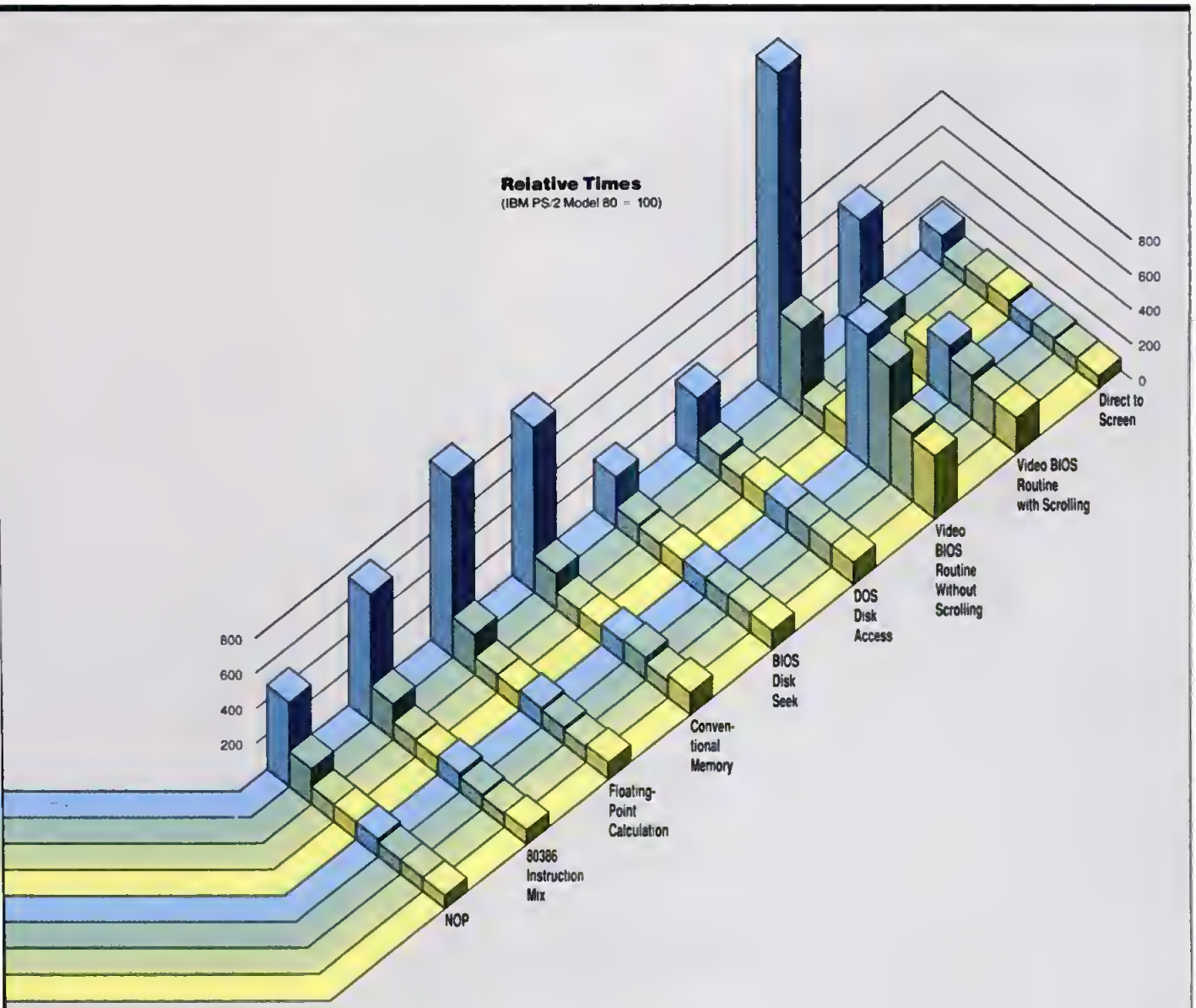
The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these became single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

The **DOS Disk Access** benchmark test measures the time it takes to do a random sector read using DOS. DOS buffers are set at 3 and the interleave factor is left at the drive's default setting. This test adds DOS's overhead to the BIOS and hardware times. The test program per-

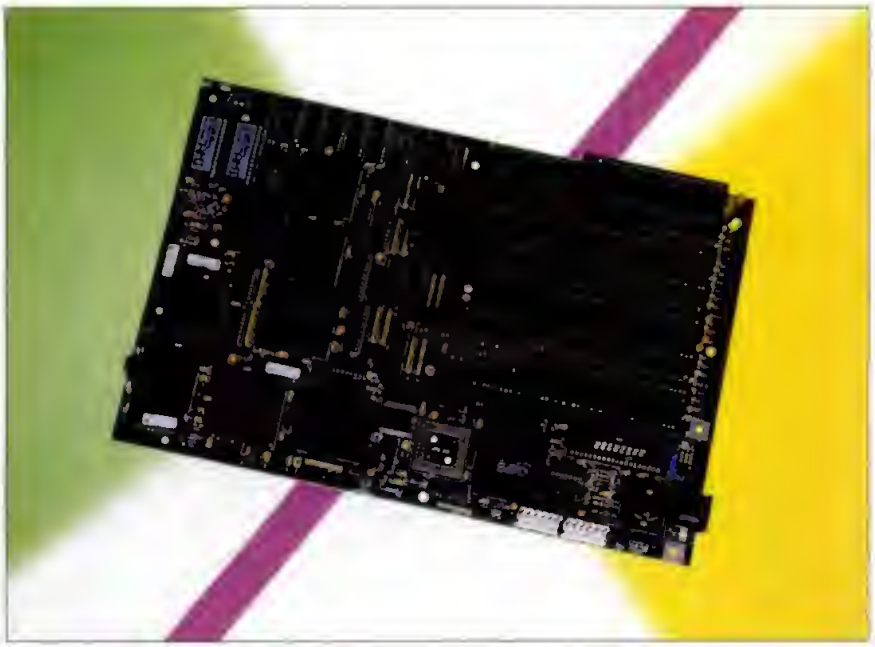


forms the sector read 1,000 times within the DOS disk partition. The average result is shown in milliseconds.

The **Video BIOS Routine Without Scrolling** benchmark test measures the speed of the BIOS Teletype routine without scrolling. The test is performed in video mode 3. The screen is cleared and 24 lines of 80 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. This is done ten times, and the result shown is the total of the ten trials.

The **Video BIOS Routine with Scrolling** benchmark test measures the speed of the BIOS Teletype routine with scrolling. The test is performed in video mode 3. The screen is cleared and 240 lines of 60 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. Although the first 24 lines written to the display do not involve scrolling, all the remaining lines scroll the display.

The **Direct to Screen** benchmark test measures the bandwidth of the video adapter by writing directly to the display memory buffer. The test is performed in video mode 3. The entire screen is updated using the assembly language REP STOSW instruction with register CX equal to 2000. This is done 1,000 times, and the result shown is the total of the 1,000 trials.



Probably the best upgrade for existing ATs, the Microframe 386 can also serve as the foundation for a computer in its own right. Header-style switches are included for attaching indicators.

croframe 386 is almost small enough to fix XTs, but one corner of the board bumps into the XT drive bay. Monolithic Systems is working on a new board with a notched corner that will fit.

The Microframe 386 includes a full complement of expansion connectors—eight—spaced on the 0.8-inch centers of AT and XT standards. Six slots use the 16-bit AT bus design, two the 8-bit XT bus. The two rightmost slots—those that the left XT drive bay would intrude upon, limiting their use to so-called short cards—include one of each bus width.

Monolithic Systems makes no allowance for 32-bit expansion, relying instead on the large memory capacity of the Microframe 386. All RAM is installed on SIP (Single In-line Pin) memory modules, with sockets provided for eight, in four pairs arranged end-to-end, squeezed between expansion slots.

The location of the SIPs is a mixed blessing. It puts the memory in a choice location—where the action is on the bus—and it saves board space, putting otherwise valueless real estate to work while not interfering with normal system expansion. On the negative side, the modules are difficult to remove should you want to upgrade or need to replace one.

The only hardware adjustments on the Microframe 386 are setting monitor and coprocessor jumpers.

The memory is arranged in two banks of four modules each, each bank filled as standard equipment with 256K SIPs, for a total of 2MB. Using one 1MB SIPs, the total 80386 Mother Board memory can be stretched to 8MB.

Memory is two-way interleaved and addressed in 2K pages with one four-SIP bank, 4K with two banks installed. The number of wait states inserted in memory accesses can be software programmed.

Normally, 640K is allocated to DOS, 384K shadow RAM is used for speeding up BIOS routines, and the balance goes for extended memory. According to Monolithic Systems, DOS memory can be stretched to 704K with monochrome video adapters or 736K with a color/graphics adapter.

Besides replacing AT system boards, the Microframe 386 can serve as the foundation for a computer in its own right. For these purposes, a number of header-style connectors are included for attaching indicators and switches.

The right side of the board has a pair of pins for a reset switch and a novel "running" LED. More than just a pilot light, this indicator is designed to go out should the 80386 microprocessor halt, unambiguously revealing system crashes. At the left front of the board is an AT-style 5-pin connector for a keyboard lock and LED. An AT- and XT-compatible 4-pin speaker connector is also available.

The Microframe 386 board includes all other standard AT features. For instance, it uses CMOS setup memory in the same configuration, and accessible by the same techniques (including the IBM AT Setup procedure), as ordinary ATs. A continuously running clock is also built into the board. Monolithic Systems allows for two methods of powering these features: on-board and external batteries. The on-board power consists of a stack of two lithium "button" cells, type Ray-O-Vac BR2325. Six volts' worth of external batteries can connected through a 4-pin header. The two battery supplies are isolated from each other with diodes.

As with ATs, the only hardware adjustments that normally need to be made on the Microframe 386 board are setting a jumper for the primary monitor type used and another jumper for enabling the numeric coprocessor.

Power connectors use standard IBM-style rectangular pins and were properly keyed. All components and—more important, all connectors and jumpers—are plainly labeled by legends silk-screened on the board. Overall construction quality and layout are superb, with no "engineering change orders" or other afterthoughts visible anywhere.

Overall, the Monolithic Microframe 386 motherboard is probably the best up-

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grade for existing ATs. It offers excellent performance, no major flaws, and few minor ones. When the XT version becomes available, it will also rank among the best competition.

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Zeos 386 Motherboard

Although announced in the early months of 1987, the Zeos 386 Motherboard received for testing was not quite a production unit. According to Zeos International, although the board artwork was complete, difficulties with one subcontractor had led the company to seek out another for board manufacturing.

The only difference between the prototype received and the production model will be an increase from 8-layer construction to a board sandwich of 14 layers, the added strata consisting of ground-plane and pad areas to reduce radio frequency emissions below their already low level. The Zeos board itself is designed to upgrade AT-style computers to 16 or 20 MHz, 80386 operation, filling the entire full-size 13½- by 12-inch AT form factor. Some of that space is devoted to novel features that mark the Zeos product as more than just another replacement system board.

The most surprising of these is an on-board SCSI (Small Computer System Interface) connector that allows up to six SCSI drives to be daisy-chained off the system board. The Zeos implementation allows a SCSI drive of up to 32MB to boot the system.

In addition, a standard floppy disk controller that supports all standard IBM formats up to 1.44MB 3½-inch drives is also part of the Zeos system board circuitry.

PC MAGAZINE FACT FILE

Zeos 386 Motherboard
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SMOOTHING THE ROAD TO 386 POWER

Like converting an old country kitchen to high tech, closing the technology gap between PCs and XTs and the new 386s is less straightforward than doing a few simple component swaps. Fact is, changing a motherboard is more a nuisance than a problem, but it's important to understand what you're getting into before you get into it. Here are a few installation notes and tips.

Save old equipment. Just as every kitchen should have a well-stocked junk drawer, it's handy to have some backup hardware tucked away for when you need it. To illustrate the point, the Dyna SX386, like the PC AT, uses a Setup disk rather than a memory-resident setup program. Our initial setup was lost due to battery failure. When you've got an AT-class disk controller without a setup, the system defaults to the A: drive. Problem is, it assumes the A: drive is a 1.2MB high-density drive. That old reliable 360K drive most of us have can't read *anything* under those circumstances. In this instance, the solution was to replace the controller with the XT variety long enough for the system to read the Setup disk and reset the drive specification back to 360K. Sometimes the only way to upgrade is to downgrade.

Invest in disk utility software. When upgrading controllers, you need to do a low-level format of your hard disk to make the swap. And even if you don't swap the controller card, changing the drive's interleave should yield a performance boost no matter what hard disk and controller you are using with the faster replacement motherboard. This also calls for reformatting. Disk utility software allows you to perform these tasks painlessly. In this case, less pain means more gain.

Expect unexpected incompatibilities. Troubles arise when you mix equipment from different hardware generations. Keeping that old 10MB XT-class drive when upgrading to a 386 motherboard may not give you the kind of disk performance that you would usually expect.

Another example of old equipment behaving in peculiar ways happens if your newly upgraded system includes an AT-class-or-above motherboard and an XT disk controller. IBM's XT disk controller turns off the system clock during the boot-up process. The ROM on the original XT motherboard and faithful clones turn the clock back on. With the AT-class disk controller, IBM chose not to repeat the predecessor's habit, eliminating the need to undo it on the motherboard. However, mixing parts from PCs, XTs, ATs, and 386s can set the floppy disk drives spinning endlessly.

Normally, the system stops floppy disk drives after a certain period of inactivity. Without the clock, the system does not know how long they've been on, so it never turns them off.

Programs that rely on the clock will also act improperly, but the problems may be less obvious. Communications and other programs that rely on precise timings may not know what to do or when. Most replacement boards come with a simple 8-byte program that performs the needed fix (turning the clock back on), but it must be run each time you boot up your system.

The moral is, planning and the right mix of components can prevent your computer system from becoming a mass of hardware and software incompatibilities.—**Philip F. H. Rose**

Philip F. H. Rose is a project leader of PC Magazine.

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The Zeos 386 Motherboard includes several interesting extras, like a an on-board SCSI connector that allows up to six SCSI drives to be daisy-chained off the system board.

Zeos includes Future Domain's *Disk Maestro* software for configuring these mass-storage options.

The system board area in front of the keyboard connector is devoted to sockets for a total of 16 SIP memory modules. These sockets must be filled four at a time (because of the 32-bit-wide addressing of the 80386), although for the base price none are. Either 256K or 1MB page-mode SIPs can be used, for up to 16MB on the board.

Nominally, memory pages size is 2K, but when two or four four-SIP banks are installed, the memory operates with a two-way interleave and page size increases to 4K. Two proprietary 32-bit expansion slots allow further memory expansion, up to the 128MB supported by the Zeos board. The company promises a 16MB expansion board for delivery in the second quarter.

The first 640K of RAM is devoted to DOS. The next 384K can either be used as shadow RAM or switched off entirely. The balance of RAM is addressed in the extended area.

An 80387 numeric coprocessor socket on the Zeos board accepts either that chip or an adapter board and a 80287 which can operate at up to 12 MHz. A jumper on the motherboard allows the use of either a CMOS or NMOS 80287. Header-pin connectors are available for a loudspeaker, keyboard lock and LED, an external 6-volt battery supply, and a reset switch. Two slides are also mounted on the board: one to select monitor type, and another to switch power to the nonvolatile (CMOS) memory off. Software that comes with the Zeos board allows programming system operation into illegal configurations that will lock it into a nonworking state. This switch allows you to reset the CMOS RAM to the factory defaults.

The Zeos board's versatility should appeal to the technically sophisticated user.

Eight connectors in standard 0.8-inch AT spacing comprise the expansion bus. Two are 8-bit, four are 16-bit, and two are 32-bit (which can also be used as 8-bit slots). The expansion bus operates at one-half or one-third the speed of the microprocessor, or at the speed of a separate oscillator (nominally 8 MHz but upgradable to 12), all with modes jumper selectable.

You have your choice of a BIOS from either Phoenix Technologies or Award Software. The same choice applies to the keyboard chip, set up for an AT-style keyboard.

Versatility is the key virtue of the Zeos board. It should appeal most to the technically sophisticated user who can put its advanced features to use. It may be more than a casual user will want to deal with.

Winn L. Rosch is a contributing editor of PC Magazine.

PC MAGAZINE EDITOR'S CHOICE

• For PC: Hauppauge 386 MotherBoard
• For XT: Dyna SX386, Monolithic Microframe 386
• For AT: Monolithic Microframe 386

What replacement system board you buy depends on what you want to replace. If you have an ordinary PC, the only choice is Hauppauge Computer Works' 386 MotherBoard. Fortunately, it would be a top selection even if the choice were not so limited.

The competition for XT updating is fierce. While the Hauppauge board is the best buy, you'll get more performance from the Dyna SX386 or Monolithic Systems 20-MHz boards. Any of them would be an excellent choice. In the AT arena, the Monolithic Systems Microframe 386 board stands out. Compact, up-to-date, and fast, it's a superior design that you won't soon outgrow.

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[*DIAMOND* is not copy protected]
Memory Requirements 320K Minimum

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CIRCLE 292 ON READER SERVICE CARD

Living with LOTUS

Word processing, database, and graphics add-in applications and utilities for 1-2-3 have picked up where the program left off, making it a truly all-purpose business program. Three million buyers can't be wrong.

Windows, shmindows. So you want an operating environment? Have we got a deal for you. You should do so well with those boys from Redmond. In fact, you probably already *have* this one, for free already. Such a deal! It's called *Lotus 1-2-3*.

That's the approach Lotus has taken toward customers who want more than *1-2-3* offers. Or, to put it another way, for customers who want to make *1-2-3* into an all-purpose tool.

You don't need to go buy some fancy-shmancy word processor just to write a letter; they'll show you how to do it within *1-2-3*. You don't need a graphics program just to turn out some nice 3-D graphs; you can do it with *1-2-3*. You don't have to fool around with some new program if your database needs have outgrown the *1-2-3* worksheet; they'll show you how to do your data in *1-2-3* after all.

Trying to turn *1-2-3* into the chicken soup of software—good for whatever ails you—may sound like a far-fetched idea. In practice, it's worked well. And Lotus users are finding that familiar spreadsheet-look display can lead them into worlds of applications apparently unrelated to rows and columns of numbers.

Though many of the 3 million or so buyers of *1-2-3* use it with a handful of other application programs established as the standards within their companies—say, *MultiMate* for word processing, *R:Base System V* for database management, and *Freelance Plus* for presentation graphics—hundreds of thousands of others have only *1-2-3* and DOS on their hard disks, perhaps joined by a few specialized, industry-specific programs.

These *1-2-3* users see the program as their standard "general-business" software and expect it to do the usual range of general-business work. And it does.

Though it's awkward, and no power user of word processing software would put up with its limitations, you certainly can write a memo or letter within *1-2-3*—without any kind of add-ons. Just start typing in column A. Let the text spill over to column B, widen both columns as needed, and set your left, top, and bottom page margins for printing just as you would for

any *1-2-3* spreadsheet. You won't get convenience features like word wrap or search-and-replace, but clever macros can get around some of those problems.

And a database? Why, that's the "2" in *1-2-3*. In truth, *1-2-3*'s database feature is a lot better suited to simple list-keeping than any serious DBMS work, but an awful lot of database programs are used for nothing more than flat-file lists of a few hundred to a thousand or so entries—a function handled very well by *1-2-3*, right out of the box. There aren't any data-input forms: you'll have to type in data line by line, cell by cell, as with any other Lotus spreadsheet. Your ability to select records from the database and sort them will be more limited than with most true DBMS programs. And the print-formatting options for output of your database records are few and primitive.

And graphics? Enough bad things have been said about *1-2-3*'s feeble graphics over the past 4 years that we hardly need to rough up Lotus over those ugly graphs once again here. But amid all those condemnations of *1-2-3* output as presentation graphics, don't forget that *1-2-3* produces *superb* analytical graphics: touch a few keys and in just a couple of seconds you'll see what your numbers really mean. Or use two monitors, and you can manipulate the numbers on one while watching the graph update itself automatically, virtually in real time, on the other.

HAMBURGER HELPERS But those are all really compromises. When Jonathan Sachs and Mitch Kapor put together *1-2-3*, they were building a killer spreadsheet, and the "2" and "3"—database and graphics—were distinctly secondary. Indeed, until very late in the game, there *wasn't* any database function in *1-2-3*: word processing was going to be the third leg of the program. At the last minute, word processing didn't make the cut and was replaced by *1-2-3*'s /Data functions.

Which *feel* more than a little added-on, don't they?

The result was a wonderfully useful program that impressed everyone who saw it. It was fast, it was smart, it had everything. Well, almost everything.

In retrospect, what's amazing—and what confirms the fundamental strengths of *1-2-3*, underscoring how it gained its market-leading position—was that we *expected* it to do everything. We hadn't asked that of previous programs, nor of many since. But since *1-2-3* did what it did so well, we somehow expected it to do everything else we wanted.

It didn't take long for a Greek chorus of *1-2-3* add-on products to appear, stepping forward to fill in for Lotus's omissions.

The first was *Sideways*, from Funk Software. It turned spreadsheet printouts . . . well, sideways, printing them down the long dimension of continuous-feed computer paper, perforations and all, obviating the need for Scotch tape and precision alignment of dozens of pieces of paper. *Sideways* was soon followed by other clever add-on products. Some, such as the simplified linear programming tools in General Optimization's *What's Best!*, added important features missing from *1-2-3*. Others, including almost every PC graphics program, fixed things Lotus got wrong, turning the dross of *1-2-3* graphs into the gold of boardroom-quality presentation graphics. Still others, like the *Cambridge Spreadsheet Analyst*, helped users find out where *they'd* gone wrong in a worksheet.

■ Lotus add-ins have become hits because they deliver real value for remarkably low prices—often under $100.

But all of these "Lotus stretchers," the Hamburger Helpers of PC software, suffered from one problem: you had to save your *1-2-3* file, exit the program, load the add-on, read in the *1-2-3* file, then go to work on it. Worse, changes you made to the original *1-2-3* worksheet file weren't necessarily reflected in subsequent printouts from the add-ons.

ENTER THE ADD-INS In early January 1987, Lotus finally gave software developers the answer to this distant relationship between *1-2-3* and the add-ons: the Lotus Developer Tools Kit. It allowed outside software developers to latch on to programming "hooks" within *1-2-3* to call and run programs while still inside a worksheet. Thus developers could use all the heavy guns of *1-2-3*, from the moving-bar-style menu to Lotus's print drivers, file format, and so on, while adding whatever functionality they thought you and I would buy.

No longer would developers have to write products which added *onto 1-2-3*; now they could add *in* their ideas about how the program could be improved. And at least in theory, users could construct their own little idiosyncratic kits of those add-ins, turning *1-2-3* into what *they* thought it should have been all along.

Copies of a similar developers' toolkit for *Symphony* add-ins had been floating around for some time, and Geoff LeBlond, who had published a set of BASIC-language programming extensions for *Symphony* as an add-in, was the first to market with a *1-2-3* add-in, *4Word*. Released through Turner Hall Publishing, a subsidiary of Symantec already in the Lotus add-on business with *SQZ!* and *Note-It*, *4Word* enjoyed immediate success.

Legions of Lotus letter-writers were freed from the tyranny of column widths and learned to love word wrapping, searching and replacing, and the rest of modern word-processing technology.

4Word was quickly joined by two very good competitors, Blossom Software's *Write-in* and *InWord* from Funk Software (reviewed in this issue), and the Lotus vision of each *1-2-3* user being able to customize the program moved a step closer to reality.

Actually, the differences among those first three WP add-ins for *1-2-3* showed that the customization possibilities available through add-ins were even richer. Because the three programs employ very different approaches to word processing, users can make a choice among program *styles*, as well as simply adding a new feature to their favorite spreadsheet software.

Lotus add-ins have become hits because they deliver real value for remarkably low prices—often under $100. The only other admission ticket is that you must be using *1-2-3*, Release 2.0 or later:

MEMORY MATTERS

One problem with Lotus add-ins is that they're memory hogs. Well, maybe not so much as they may at first seem, considering how valuable some of them are . . . but still, they absorb precious RAM. And the Lotus Add-In Manager wants another 20K. Try loading two or three add-ins, at an average of 75K each, plus the Add-In Manager's 20K, a corpulent recent version of DOS, and *Lotus 1-2-3* itself, and watch your memory disappear.

So where are you going to put your *spreadsheets*—the reason you use *1-2-3* in the first place?

The new Lotus-Intel-Microsoft expanded memory specification, Version 4.0 (LIM EMS, or LIMspec 4.0), offers an almost perfect solution. It allows program code, not merely the data being manipulated by that code, to be loaded into expanded memory. While programs executed from EMS memory load a tad slower than if called from the 640K of conventional RAM, the difference is slight and probably unimportant in the case of add-ins.

But . . . none of these add-ins yet support LIMspec 4.0. Nor, for that matter, does the latest release (2.01) of *1-2-3*—though Lotus has promised 4.0 support in the new *1-2-3*, Release 3.0, due sometime in the first half of 1988. Current versions of *1-2-3* (beginning with Release 2.0) *do* support the earlier LIMspec (which can use only expanded memory for data), but among the add-ins reviewed here, only a few (see features table) can use even that more-limited facility.

The moral: Be selective in loading add-ins; flush 'em from memory when you're through with 'em; and avoid the temptation to auto-invoke them—that is, load them automatically—when you're calling up *1-2-3*.—**Jim Seymour**

add-ins don't work with Release 1a. But now that Lotus has the kinks out of Release 2 with its "maintenance release" of 2.01, there are plenty of other good reasons to upgrade from 1a or 1a*. More than three-fourths of Lotus users already have.

MANAGING ADD-INS The key to customizing your copy of *1-2-3* with add-ins is the Add-In Manager, written by Lotus but supplied with each *1-2-3* add-in by that program's publisher. Installing the Add-In Manager is a one-time job, handled by a batch file on the add-in program disk. This makes your *1-2-3* driver set aware of the existence of the Add-In Manager.

Once it's installed, using the Add-In Manager to call your add-ins is fast and easy. You can set up your add-ins so they can be called by an Alt-F7, F8 or F9 keystroke; or you can use the Add-In Manager's special Attach/No Key option to call the add-in from a list when you need it. You can even set the Add-In Manager to automatically load one or several add-ins every time you load *1-2-3* into memory. (As appealing as that auto-loading sounds, however, remember that *1-2-3* and DOS already consume a lot of memory; for most uses, calling add-ins only as needed makes more sense.)

To use an add-in, just hit its Alt-function key combination while in the Lotus spreadsheet; or, if you didn't assign that add-in to its own Alt-function key combination, hit Alt-F10 to call the Add-In Manager, hit Enter to select "Attach," use the arrow keys to move the cursor to the add-in you want, and hit Enter twice. That loads the add-in into memory.

Then, with the Add-In Manager's menu still on-screen, hit the 1 key for Invoke. A list of all the add-ins you've installed appears across the top of the screen, looking very much like a list of *1-2-3* worksheet files ready to be retrieved with the /File Retrieve command. Move the bar cursor across to the name of the add-in you want to use, hit the Enter key to select it, and your add-in is on-screen.

YOUR OWN TOOLKIT Developers of *1-2-3* add-in programs go out of their way to make their own moving-bar menus look very Lotus-y. Use the arrow keys to move across to the command you want, then hit the Enter key; or just tap the key for the first letter of the name of the command—in both cases, exactly as you do with the Lotus worksheet itself.

Some add-ins save your work as part of a standard *1-2-3* .WK1 file; others write the data into a separate file outside *1-2-3*. Generally those programs that save data outside the *1-2-3* worksheet offer larger, more-sophisticated data files and help avoid the agony of discovering you've just overwritten some important *1-2-3* cells beneath the area you *thought* you were working in. On the other hand, those that save the data inside a .WK1 file may make it easier to exchange data with other people who don't have copies of the add-in used to create the material.

Which add-ins are for you? It's hard to say, because *my* short list of best add-ins has grown out of the unique ways I want to stretch *1-2-3*—which may not match your needs at all. Indeed, that's the whole point of add-ins: they allow us to customize what is, for many of us, our most fundamental applications program—*1-2-3*—into a tool closely matched to our own needs.

Not to be coy, I use *SeeMore* almost constantly, to see more of the spreadsheet at a time; I use the add-in version of *Sideways* frequently, for easier assembly of really large spreadsheets. I use Informix's *Datasheet Add-In* almost daily with a database developed by a client in that format. I use *Write-in* for the occasional fast note when I'm working in *1-2-3*; and I load Intex Solutions' *3D Graphics* once in a while, to play around with visualizations of data that require three axes to make sense.

A FEW TIPS Experience suggests a few things potential add-in users should consider. First, add-ins are a game for those with 640K RAM and a hard disk. While you can get away with running add-ins on a floppy-disk-based system with less than 640K, you'll soon get into out-of-memory problems, and you'll go batty deleting files on your *1-2-3* program disk in an effort to make enough room for the Add-In Manager and the add-in program itself.

Second, be careful when installing your second and subsequent add-ins. Lotus has

shipped several versions of the Add-In Manager, supplying them to add-in developers who provide them on your add-in program disk. The installation procedures for add-ins usually make clear that if you're already using *any* add-in, you don't need to reinstall the Add-In Manager.

But check the file creation dates on the two Add-In Manager files found on your new add-in's disk. They're called ADD_MGR.EXE and ADD_MGR.DRV, and the DOS DIRectory command will show you their creation dates. If their (common) date is more recent than the date on which the files of the same name that you've already installed on your hard disk were created, install the newer versions.

By the same token, *don't* accidentally overwrite a more-recent Add-In Manager with an older version you may find on a disk in an old add-in's package (or on a disk from an add-in developer who's sloppy about providing the latest version of Lotus's work).

Third, don't overlook subtle, off-the-beaten-path uses of your add-ins. You may be able to use add-in word processors, for example, to dress up your spreadsheets with italics, boldface, and underlining. And while most users think of an add-in spelling checker as a utility intended mainly for use with an add-in word processor, *Spellin!* can just as easily check the text in your worksheet as well. Your colleagues can live without spreadsheets with "FY87 Actule vs. Forecast" titles, or *1-2-3* graphs with pie slices identified as "Southwuest" and "Uper Midwest."

Finally, using an add-in word processor with good ol' *1-2-3* is very nice if you're a busy executive and want to write only the occasional memo or short report. But if you're likely to pass that report onto someone else in electronic form, on a network or through Floppy Frisbee, you may be better off learning to use the WP program that's the standard at your company. Don't be surprised if you find you really do have use for some of that full-featured WP program's bells and whistles after all—despite how good the add-in WPs may be.

ADDING ON ADD-INS With *1-2-3* add-ins already available for an amazing range of ancillary functions, where do add-in developers, and add-in applications, go from here?

Eric Schultz, who helped develop *1-2-3*, Release 2, when he was at Lotus, left to cofound Blossom Software and develop its first (and only) product, *Write-in*—a product so good that it serves both as a model for others on how to write add-ins and as an example of how powerful they can become. He believes the next obvious add-in is a communications module.

"It would be so easy. And so many people want that. It's the one obvious missing link. We talked a lot about how obvious it was, and were sure someone would have done one by now. If I'd known no one else would have one out by now, we'd have done one at Blossom."

Paul Funk, founder of Funk Software and author of both the original add-on *Sideways* and the newer add-in version, believes people are looking for more generalized add-in toolkits—and, by the time you read this, will have shipped one.

"We don't need another word processor. We've already done *Sideways* as an add-in, and *InWord*, and *Noteworthy*, our add-in cell-annotation program. I think people want very horizontal applications to run from within *1-2-3*—which is a very horizontal program itself."

Tom Byers, who heads Turner Hall, the first and still the leading add-in publisher, has been overseeing the slow process of converting many of his company's older add-ons, such as *Note-It*, *SQZ!* and *Cambridge Spreadsheet Analyst*, to add-ins. Add *4Word* and *Spellin!*, and it's easy to see why Turner Hall dominates the add-in market.

Byers sees additional market opportunities for add-ins—and is about to release *4Views*, an add-in reminiscent of Borland's *Reflex* in the way it serves as a *1-2-3* report writer and constructs crosstabs from *1-2-3* worksheet datasets. But he thinks the next generation of add-ins, written to work with *1-2-3*, Release 3.0, due during the first half of 1988, will be fundamentally different.

A NEW LEAF In one sense, they'll *have* to be different: Lotus has warned add-in developers that *1-2-3*, Release 3, won't be able to use existing add-ins. "But Lotus has also said LEAF, the new Lotus Extended Applications Facility, a new language for tying together applications, will be a way we can write add-ins for Release 3," says Byers. "That should allow us to develop much richer products."

Another source confirms that despite earlier reports, Lotus has now told add-in developers that while no special LEAF-based add-in developers' toolkit will be produced, they'll be able to get copies of LEAF about the time *1-2-3*, Release 3, is shipped and should be able to ship their own new add-ins shortly after that.

The release of products such as *Microsoft Excel* has led some to suggest that a special class of add-ins will be developed for *Windows* applications, such as *Excel*. That seems unlikely, since users of *Windows* can already jump from one application to another, cut and paste from one to another, even pass data from one to another through *Windows*' Dynamic Data Exchange feature.

It seems more likely that we'll see sophisticated, multi-worksheet template sets for *Excel*. Byers agrees: "I think we're going to see things like a 'budget construction set,' akin to the 'Pinball Construction Set' game, for *Excel*," he says. "*Excel* just invites that sort of thing—and anyway, it has a lot of the things add-ins bring to *1-2-3* already built into the product."

Other existing spreadsheet programs may not have a sufficiently large installed base to support development of their own versions of add-ins. Computer Associates' Micro Products Division is addressing the need for add-ins for their *SuperCalc4* pro-

OUR REVIEWERS

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–Walter Affourtit, West Islip, NY

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#6

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gram by developing its own—and also releasing them for *1-2-3*.

New spreadsheet programs may come to market with add-in-like features already built in (*Surpass*, for example), or with a series of add-ins already planned and in development by their publishers (as with Borland's *Quattro*).

Another path will be "do-it-yourself" add-ins. *Quattro* was designed for easy add-in development, using Borland's Turbo C and Turbo Pascal language packages. Borland president Philippe Kahn has said the company plans to help users develop those DIY add-ins. Corporate PC and MIS managers will love that ability to create in-house the custom add-ins their users need.

Finally, given the popularity of bundling in the PC business, it's likely that other publishers will follow Borland's lead in another direction as well: look for copies of the Turner Hall add-in *SQZ!* bundled with *Quattro*.

Between the universe of fully independent but highly compatible separate programs, such as *Windows* applications, and the much smaller world of single, tightly integrated multifunction programs such as *Framework*, lies the no-man's-land Lotus is trying to absorb with add-ins.

Cynics say add-ins are an easy out for Lotus, saving it the time, expense, and development resources needed to deliver that much more fully functional *1-2-3* it "should" have. But as *PC Magazine*'s West Coast editor Jared Taylor likes to point out, a program that does everything everyone wants is so big and slow that it can hardly get out of its own way.

And there will *always* be someone who'll say of it, "Now if they had just . . . ."

Add-ins are a tidy, inexpensive, highly personalized way to extend *1-2-3* in the directions you think it should go. And to leverage off your existing investments in both purchase price and time spent learning *1-2-3*, by making it a tool even more broadly useful in your work.

Now if they just had an add-in manager to keep my daily schedule . . . and one to check my MCI Mail box . . . and one that could . . . .

Jim Seymour is a contributing editor of PC Magazine.

Word Processing ADD-INS

Since processing words and constructing spreadsheets always come up as The Big Two business-PC applications, it wasn't surprising that the *first 1-2-3* add-in was a word processor. Nor that before long we had no fewer than three competitive add-in WP products—more than in any other add-in category.

What is surprising, though, is how different the three are in concept and in their approach to the job of pushing words around. And how good all three products are. Choosing among them is less a matter of picking the *best* product than finding the one that most closely matches your own style of handling word processing—the one that offers the right approach and feature-set for your needs.

4Word

The first add-in product to appear was Turner Hall's *4Word*. In some ways it's a cross between the brute-force, stack-all-your-text-in-Column-A approach of word processing in *1-2-3* without add-ins, and the clumsy approach Lotus took with *Symphony*—with a lot of very nice features added around the edges.

4Word saves text as a series of left-justified *1-2-3* text labels in Column A at the left edge of the worksheet. It relieves that stuffed-column feeling by replacing the *1-2-3* screen (including *1-2-3*'s distinctive baby-blue row-and-column identification bars) with a plain, attractive screen that looks like a traditional WP program's display. The *1-2-3*, Release 2.0 date and time information appears lower left (assuming you've left that display turned on in Lotus's /Worksheet Global Default Other Clock options), as well as the Lotus status ("READY" or "WAIT") flag at upper right, and the NUM and CAPS flags at lower right. (Unfortunately, it also leaves the Lotus CALC flag on-screen throughout the word processing session. Turner Hall promises this will not be the case in the upcoming Version 2.0 of *4Word*.) *4Word* adds a border around a 19-row by 78-column typing area, with tab markers across the top.

The usual word processing features, from word wrap to search and replace, are present. And *4Word* makes good use of the function keys, remapping them to its own purpose. Tapping the F1 key brings up a help-topics menu better than *1-2-3*'s own, including a map of which function keys do what.

Like *WordStar*, *4Word* normally does not reformat paragraphs manually when you enter or delete text. That's a remarkable step backwards, but users can select an auto-reformatting mode. Turner Hall warns, though, that auto-reformatting is much slower and suggests leaving the setting on manual. I wasn't bothered by the slightly slower speed of auto reformatting on 80286 and 80386 PCs nearly as much as I was by the clumsiness of having to manually reformat changed paragraphs (or whole documents), but when I installed *4Word* on an XT, I saw what they meant: auto-reformatting can be slooow.

4Word can handle mail-merging from *1-2-3* databases (and you can use the native *1-2-3* /Data Query Extract facilities to sort and select the records from the database to be merged, though that must be completed before entering *4Word*); and it can use *Lotus 1-2-3* macros.

In the interest of a simpler display, *4Word* doesn't leave its moving-bar, Lo-

PC MAGAZINE FACT FILE

4Word
Turner Hall Publishing
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600
List Price: $99.95
Requires: 64K RAM, *Lotus 1-2-3*, Release 2.0 or later.

In Short: *4Word* is a well-integrated program that extends *1-2-3*'s functionality to include enough traditional WP features for executive memo and letter writing. Use of *1-2-3*'s print drivers limits output options and quality. *4Word* is best for *1-2-3* users who need WP capability only occasionally.

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Here's what people are saying about Magic Mirror.

"Just received the program and was able to install and use it in a matter of a few minutes..."
–John Snyder, McNaughton Baptist Church, Akron, Ohio

"Fantastic!... probably paid for itself yesterday PM (I received it about noon yesterday) in putting together a report by moving analyses from 1-2-3 to WordPerfect. Not only time, but accuracy since I'm not the greatest typist."
–B.T. Elliot, P.E., Birmingham, Alabama

"A RAM-resident gem that accomplishes what I heretofore believed was impossible: [integrating] data between virtually any two programs."
–Jack Stone, PhD, Government Computer News

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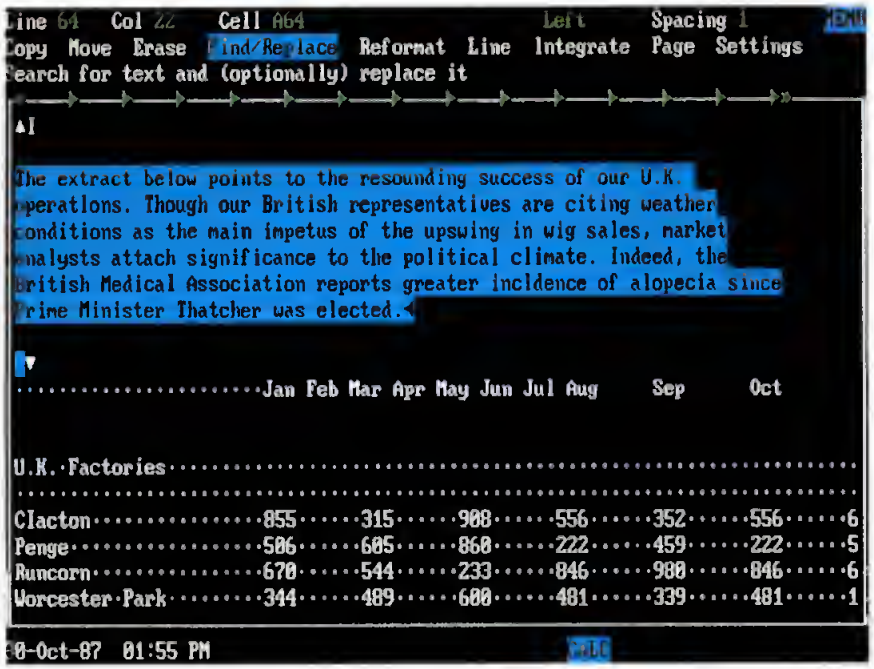

4Word's menu structure and feature selection follow 1-2-3 conventions, making it easier for Lotus users to maneuver. For a cleaner screen, hit the F10 key and the menu disappears.

tus-like menu across the top of the screen all the time, but shows it only when you strike the F10 key. (You can't call it with the usual *1-2-3* Slash key, of course, because you may want to use the slash sign as a legitimate text character in your *4Word* documents.)

Just as with *1-2-3*, you can either hit the key representing the first letter of the menu choices (C for Copy, M for Move, and so forth), or use the cursor keys to move across from one menu choice to the next, then hit the Enter key to execute the command. As with *1-2-3*, the cursor key method adds keystrokes but offers the benefit of short, explanatory lines appearing under each successive menu keyword to remind you of what lies in the submenus below.

PROCEED WITH CAUTION A price exacted by *4Word*'s trick of stashing your text as long labels in Column A is that as your document grows longer, it's easy to overwrite real spreadsheet information—formulas, text labels and values—you've already entered in *1-2-3*'s native mode. (*Symphony* users will immediately recognize this unlovely artifact from their program's archaic text-entry style.) To avoid overwriting data, *4Word* offers a Settings Range Restrict command that creates a named range for word processing, then forces *4Word* to stay within whatever row-and-column boundaries you've set. But add more text than will fit in that space, and you must go back and expand that range manually.

(Version 2.0 of *4Word* will automate the setting of a restricted range to avoid overwriting data. The new version will also offer an undo feature on block moves and deletions and will kill the CALC flag at the bottom of the screen.)

And while *4Word* can read in, display, and print patches of your spreadsheet within a *4Word* document, it can't deal with more than one file at a time. Thus you can't follow the obvious path of writing your letter, then at the appropriate point(s) calling for a range of data from another spreadsheet. You'll have to drop out of *4Word*, use *1-2-3*'s /File Combine commands to bring the data range into an unused area of your *4Word* spreadsheet—remember, *4Word* documents are spreadsheets—then return to *4Word* using its Integrate Link command to call that range into your document.

In compensation for this ridiculous dipsy doodle, *4Word* lets you create "hot links" between those patches of worksheet embedded in the document and their cells in the normal *1-2-3* worksheet—so that if you subsequently change the data in the worksheet, it's automatically changed in the document as well. But the other WP add-ins reviewed here also offer similar hot links, without so much zigzagging.

In Version 1.0, *4Word* can't integrate *1-2-3* graphs into your document. The upcoming version 2.0 reportedly will ship with a second add-in included at no extra charge, *4Graph*, which will allow integration of *1-2-3* graphics into *4Word* documents—or directly into *1-2-3* row-and-column printouts. Unfortunately, that process will require saving the desired graphs as .PIC files in advance; and, since *4Word* and *4Graph* will still rely on Lotus's printing resources, you'll have to dredge up your long-lost PrintGraph disks to print those integrated documents.

PRINT TIME Printing *4Word* documents relies on the *1-2-3* printer drivers and standard *1-2-3* printing techniques. In fact, *4Word* has no print routine; you simply drop out to *1-2-3* and use the usual /Print Printer Range Align Go command sequence. That means *4Word*'s printed pages suffer from the limitations of *1-2-3*'s printer drivers: no support for proportional fonts, difficulties in changing character size, no management of soft fonts for laser printers, and others.

You'll also need to be careful to set the *1-2-3* right-hand page-margin default to a number larger than the actual line width of your *4Word* document, or the ends of longer lines will be chopped off. Turner Hall suggests setting the *1-2-3* right-hand margin at its maximum value, 240 characters, to avoid conflicts.

4Word's a good choice for the occasional WP user who just wants a better way of writing letters than typing text directly into a *1-2-3* worksheet. Note too that at a little less than 64K, *4Word* uses less RAM than do the other products reviewed. While it's easy enough to purge add-ins from memory and regain that memory for worksheets, you may never need to unload *4Word*, thanks to that modest memory requirement.—**Jim Seymour**

InWord

Of all the *1-2-3* word processing add-ins, *InWord* is the cleanest, fastest, easiest to use. It follows the pattern of *1-2-3*'s own menus more closely, and you probably won't even open its excellent manual. This is a program for *1-2-3* loyalists, who want their word processing to look and work as much like good ol' Lotus as possible.

Funk Software, developers of *InWord*, were the first entrants in the *1-2-3* add-*on* market with the original version of *Sideways*; they have now become major players in add-ins as well. That experience shows in the polish and ease of use of *InWord*.

InWord's WP display uses the topmost line for a character size and attribute note at top left (such as "10 cpi boldface"), and a mode indicator reminiscent of *1-2-3*'s READY flag, at top right. Next come two lines reserved for the moving-bar menu. Lotus's date and time readouts appear at the lower-left-hand corner of the screen, and the Lotus NUM and CAPS flags are at bottom right. Like *4Word*, *InWord* draws a border around a text entry window containing 19 rows by 76 columns. The top line of that window shows margins and tab settings in traditional WP-ruler style.

Text entry is straightforward. You can call the moving-bar menu at any time by hitting F10. The F1 key delivers a help screen that gives explanations of eight basic keys' functions; a Help Index option at the bottom of the screen will take you to a Lotus-like index of help topics, from which you can branch to still other topics, return to the index screen, or jump back into your document by hitting Esc.

To use text attributes such as italics or boldfacing, hit F3, then the first letter of the attribute (such as B for boldface), then resume typing. At the end of the passage, hit F3 and R (for Reset) to return to standard characters. To the extent that your printer supports them, *InWord* offers standard, italic, boldface and underlined characters, as well as strikethrough, superscripts and subscripts, and pitch and font changes from that same menu. You can also go back after typing material and mark all or part of your text as a block, then apply those attributes.

¿SE HABLA LOTUS? *InWord* does an exceptional job of allowing users access to the LICS, or Lotus International Character Set. Other add-ins (and *1-2-3*'s clumsy Compose command) are tricky to use to get umlauts, plus or minus signs, fractions, and so forth into your text. By contrast, *InWord* asks only that you hit the F2 key, tap F for Foreign Characters, then move the cursor to choose from among a grid of foreign-language characters shown in a pop-up window at the right of the screen. Hit Enter, and the character is inserted in your text. Symbols such as line-drawing elements, numeric fractions, and others are inserted the same way, by choosing G for Graphic Characters. (Make sure, that your printer supports those characters and that they are mapped in the printer according to Lotus's LICS scheme.)

InWord has left, right, and center tabs, plus left, right, center, and full justification. Multiline headers and footers are accommodated. And block moves and copies are easy.

Saving and retrieving your work uses Document Save and Document Retrieve commands, both reached via the F10 key. Both work just as in *1-2-3*: in fact, both pop up a *1-2-3* worksheet display with the familiar lines across the top of the screen prompting for the path and filename for the document (and listing available documents for retrieval if you've used the Document Retrieve sequence).

Like *Write-in*, *InWord* saves docu-

Word Processing Add-ins*: Summary of Features

	4Word	InWord	Write-In
	$99 95	$99 95	$99 95
RAM requirement (above 1-2-3)	64K	85K	95K
LIM EMS supported	Version 3.0 and 3.2	LIMspec 4.0	LIMspec 4.0
Word wrap	●	●	●
Search and replace	●	●	●
Automatic reformat	○	●	●
Block move/copy delete	●	●	●
Style sheets	○	●	●
Mail-merge	●	●	●
Uses Lotus macros	●	●	●
Printer drivers	○	●	○
Has hot links to spreadsheet data	●	●	●
Merges graphics	○	●	○
Saves in separate file	○	●	●

● — Yes ○ — No
*Spellin!, a spelling checker, has none of the features listed in this table

FACT FILE

InWord
Funk Software
222 Third St.
Cambridge, MA 02142
(617) 497-6339
List Price: $99 95
Requires: 80K RAM, *Lotus 1-2-3*, Release 2.0 or later

In Short: The closest match to *1-2-3*'s native look and feel, *InWord* is also a speed demon, faster at every task than the other WP add-ins. Thanks to Funk's own special printer drivers, printed output can be much more attractive than with other add-ins. A good all-around choice.

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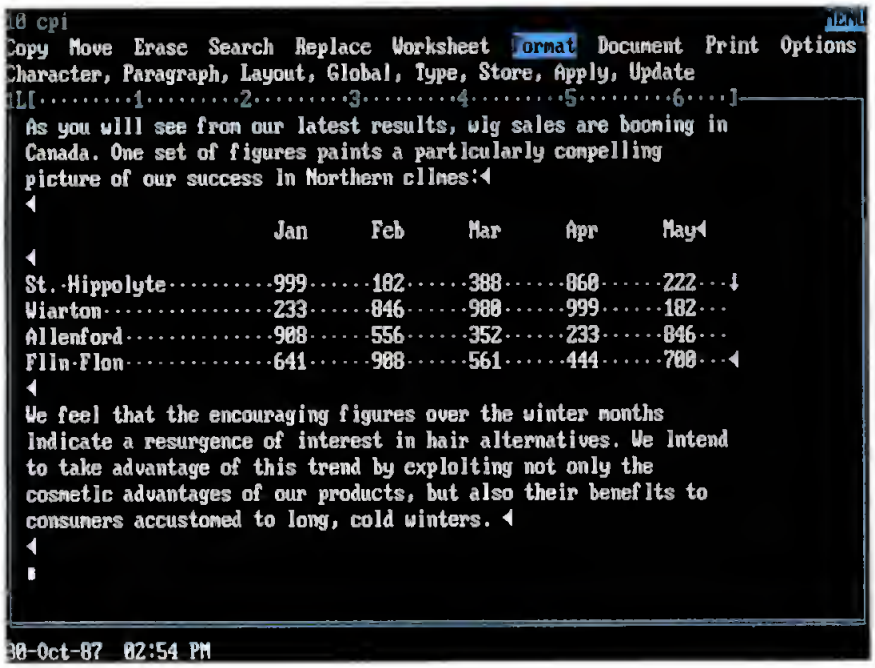

Hot links between InWord *and your 1-2-3 spreadsheet let you copy a range of data into your word processing document and make changes that will be reflected in the original worksheet.*

ments in a separate, nonworksheet file; also like *Write-in*, *InWord* has the courtesy to make a .BAK backup copy of the previously saved version. (Lotus, are you listening? Doesn't it gall you that all these add-ins handle backups so nicely? Couldn't we please finally get *1-2-3* puhleeze, Mr. Lotus?)

Though the speed and convenience of *Write-in*'s character and paragraph style sheets—and the printer-settings sheet—are hard to beat once you've set them up (or adopted one of *Write-in*'s samples as your own), *InWord*'s style of directly applying formatting in conventional terms will be more familiar to most users. And *InWord* has the richest, most versatile and understandable set of formatting commands of any of these add-ins.

CAPTURING WORKSHEETS *InWord* handles insertion of cell ranges from worksheets better than does *4Word*, but not quite so conveniently as *Write-in*. You'll need to have the worksheet from which you want to capture information on-screen before beginning your *InWord* document. At the point in your text where the worksheet range should be inserted, hit the F10 key to call up *InWord*'s menu and select Worksheet Link Table. You're dropped back into the spreadsheet, where you mark the desired range in the usual way. When you hit Enter to confirm that range, you're popped back into the word processing document, with the range nicely positioned where you want it. These are hot links, so subsequent changes in the worksheet will be reflected in subsequent printouts of the document.

Unfortunately, this approach means the worksheet patch is treated as a single block. I couldn't find a way to underline, boldface, or italicize single words, numbers, or lines within that block for emphasis.

And though both *4Word* and *Write-in* offer methods of temporarily suppressing the formatting symbols that litter most WP screens, so you can see how the finished document will really appear, I couldn't find any way of also doing that with *InWord*. (A Print View command is available, but leaves visible, for example, hard spaces and line breaks inserted by *InWord* in linked worksheet ranges, producing a "preview" screen even more cluttered than the basic working screen.)

InWord handles mail-merging about as adroitly as the other WP add-ins reviewed here. Unfortunately, it cannot combine text and graphics on the same printed page, even with Lotus's PrintGraph routines.

I like *InWord*'s clean, Lotus-like approach to word processing. And the range of its formatting options, and the ease of applying them, is very good. But be careful: the same flexibility that lets you produce the most attractive output of any of these WP add-ins, using different type sizes and proportionally spaced type, also can get you into trouble. Make certain, for example, that you choose Normal type for text in tables imported from *1-2-3* worksheets; proportionally spaced type will destroy the alignment of those tables.

DRESSING FOR SUCCESS *InWord* is a good choice for the person who doesn't care about sticking pie charts and bar graphs into letters and reports, but who does care very much about how those documents look on paper. Writing their own printer drivers was a brilliant touch for the Funk people: those superior printer drivers are the key to *InWord*'s exceptional output. And if you're a true Lotus loyalist, looking for a program that works as much like *1-2-3* as possible, *InWord*'s the one for you.—**Jim Seymour**

Spellin!

It takes a certain recklessness to market a spelling checker that can't spell its own name. (Sure, it's a play on "add-in," but still . . . .) *Spellin!* is good enough to

PC MAGAZINE FACT FILE

Spellin!
Turner Hall Publishing
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600
List Price: $79.95
Requires: 100K RAM; *Lotus 1-2-3*, Release 2.01 or later, or *Symphony*, Release 1.2.
In Short: An add-in speller for spreadsheets or *Symphony* files. More smart than speedy. Not copy protected.

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At last getting organized is painless with *Nutshell Plus*

In the past, when choosing a database, you had to sacrifice ease of use for power, and flexibility for programming skills.

No more.

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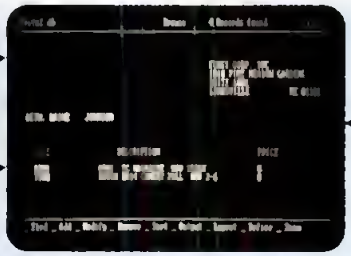
Imagine that instead of creating a monstrous single file of data, you can create logically linked files that pull related data from one to another, saving you time and keystroking, and preventing errors from redundant data entry. You don't have to program, but you **can** create macros.

Move data from file to file automatically by linking up to 10 field pairs. Here a unique account number links the Client File to the Order File, and a Product Code links the Product File to the Order File.



Create customized layouts to suit your information needs and fit your business forms. Here are two layouts in one file: an Order Entry Screen and an Invoice to fit continuous-form paper.

Format data as you wish, including optional use of dollar sign and number of digits in numbers, left and right justification of data, and five ways of displaying the date.

Nutshell Plus is features-rich. With it, you can also:

- Create a form letter in a field
- Print to screen to preview the exact appearance of your data
- Insert the current date and time with one keystroke
- Change field type
- Eliminate empty space between and within records when printing
- Preset data to avoid rekeying of repetitive data
- Use the exponentiation operator in calculation formulas
- Read files you created with Nutshell, its flat-file cousin

Visit your nearest retail dealer and try the ***Nutshell Plus*** Guided Tour Disk, then buy ***Nutshell Plus.*** At $295 we think you'll find a lot to like.

For the name of your nearest dealer carrying ***Nutshell Plus,*** call the Canterbury International Sales Office at 1-800-637-8385 (outside of Massachusetts) or (617) 881-7404 in state.

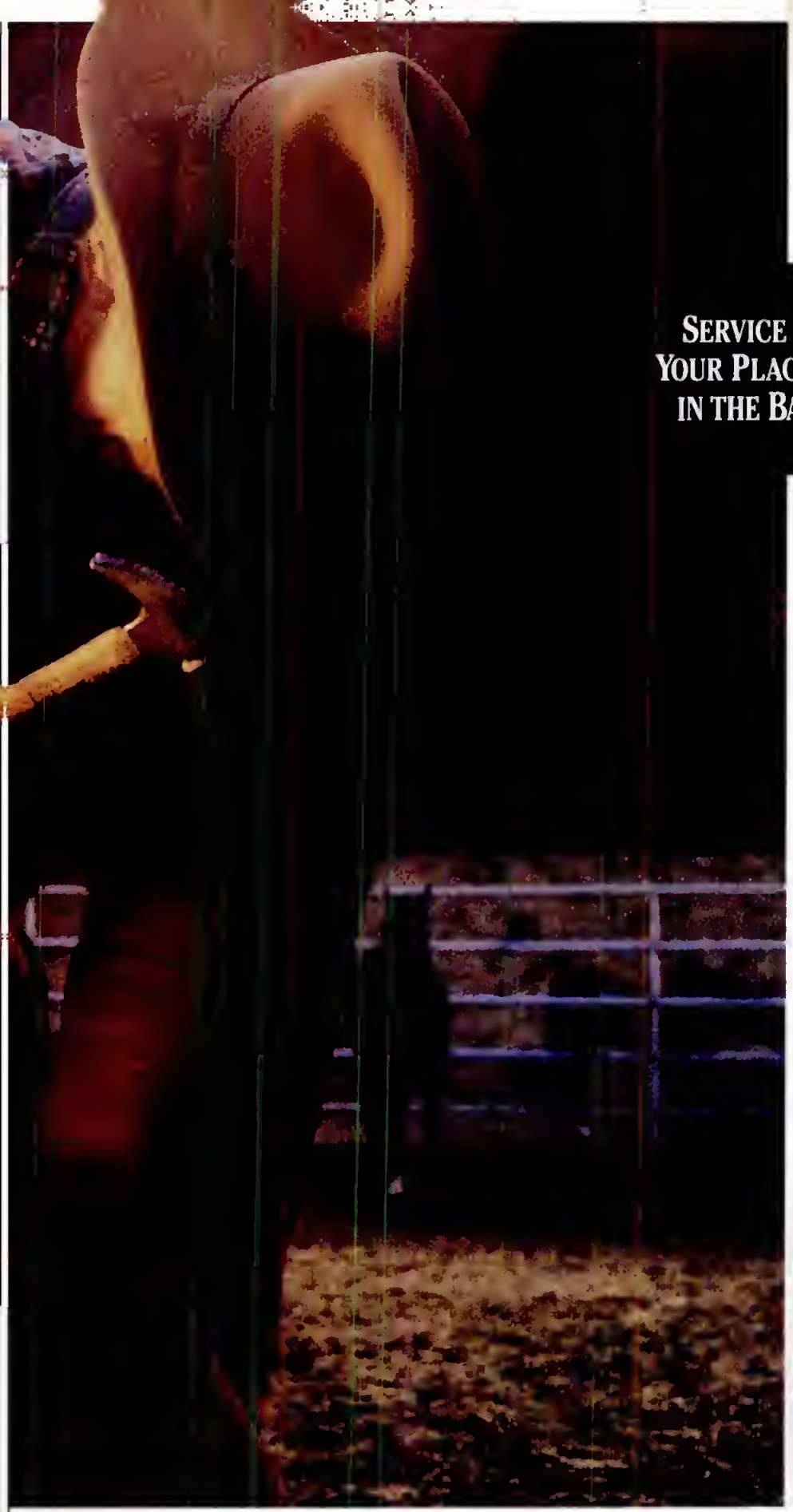
Nutshell Plus runs on the IBM and IBM-compatible PC, XT, AT, and PS/2s. It requires 384K and DOS 2.0 or higher.

CANTERBURY International Inc.

Distributor of microcomputer hardware and software

Nutshell is a registered trademark of Nashoba Systems, Inc.

11B07 MS-DOS and MS are registered trademarks of Microsoft Corporation © 1987 DELL COMPUTER CORPORATION



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8 0 0 · 4 2 6 · 5 1 5 0

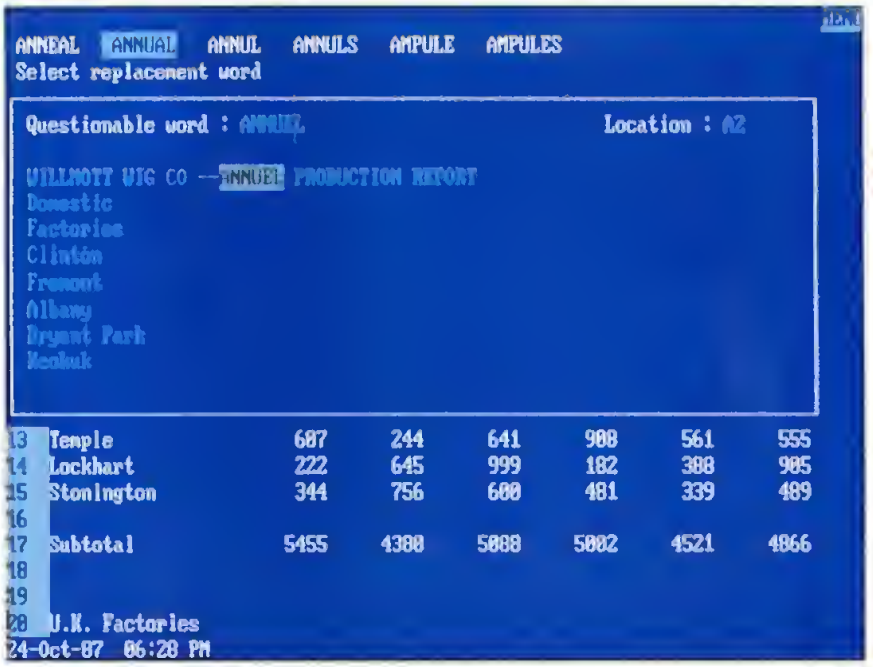
■ *Spellin!*'s vocabulary includes every business term you can think of, together with recent scientific terms likely to be used in the research labs that use *1-2-3*.

overcome the handicap of that missing "g," and it has some outstanding features that would be welcome in many standalone spelling checkers.

It takes a certain recklessness, also, to market a spelling checker for spreadsheets. You probably won't make the kind of mistakes listed on the package—*goodes*, *budgat*, *memorundum*—but a lot of copies of *1-2-3* get used as a database program, and some are even used for word processing. Typos can happen to anyone, and a spreadsheet spelling checker can come in handy if you can justify the cost. Turner Hall Publishing asks $79.95 for *Spellin!*, but you get a choice of American and British dictionaries, flexible and intelligent programming, a well-designed manual, and features like search and replace that *1-2-3* should provide but doesn't. The program also makes a lot more sense than *Symphony*'s optional spelling checker.

Spellin! integrates itself into the host program through the Lotus Add-In Manager and the *Symphony* Services command. Its hotkey brings up a menu that lets you check spelling in either a range or the whole spreadsheet. When it comes to a suspected misspelling, a menu lets you accept the word or edit it. If you want the program to suggest the right spelling, you have to use the Guess command and sit back and wait. The best standalone spellers and word processors use much faster look-up routines.

But *Spellin!* has an unusually clever way of flagging repeated misspellings. The second time the same misspelled word turns up, the program reminds you of the correction you made the first time, and offers to repeat the correction throughout the file without asking you again. It also flags sentences that don't begin with capitals (you can turn this function off) and alerts you to words that you typed twice.



When Spellin! *flags a misspelling, you can accept the word as it is or edit it. For suggested spellings, issue the Guess command and wait for the list of choices to appear.*

Spellin! gets its look-up engine and 90,000-word vocabulary (in British or American spellings) from Borland International. The vocabulary includes every business term you can think of, together with recent scientific terms likely to be used in the research labs that use *1-2-3* for organizing data. You can add custom dictionaries to supplement the main dictionary, or let the program compile a custom dictionary using the words you accept when it flags them as misspelled.

No spelling checker can recognize a word that's spelled correctly but isn't the word you should have used. Someone at Turner Hall probably checked the *Spellin!* manual with a spelling checker, but no one seems to have noticed the misspelling on page 3-13: "it is possible to loose your current Custom Dictionary." That should be "lose." You couldn't shake the dictionary loose if you tried.—**Edward Mendelson**

Write-in

Written by Eric Schultz, who wrote the specs for the *1-2-3* Add-In Manager while at Lotus, then left to develop this program, Blossom Software's *Write-in* feels more like a full-fledged word processing pro-

PC MAGAZINE FACT FILE

Write-in
Blossom Software Corp.
One Kendall Square, #2200
Cambridge, MA 02142
(617) 577-9879
List Price: $99.95
Requires: 95K RAM, *Lotus 1-2-3*, Release 2.0 or later.
In Short: A powerful, flexible program well-suited to longer and more complex documents than the other add-ins reviewed here. Internal macros, style sheets, and other features are easy to learn and use, and big time-savers. *Write-in* comes much closer to standard full-featured word processing programs than its competition does.

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Silverado's powerful combination of database outlining, windowing, background recalculation, and report summarization makes it the best add-in database ever designed for a spreadsheet. But here's the best part: *it's the database you already know how to use.*

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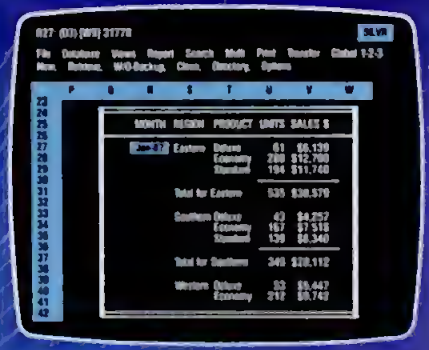
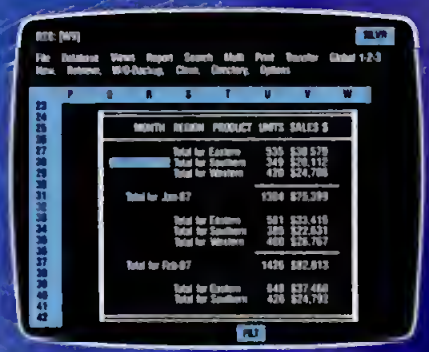
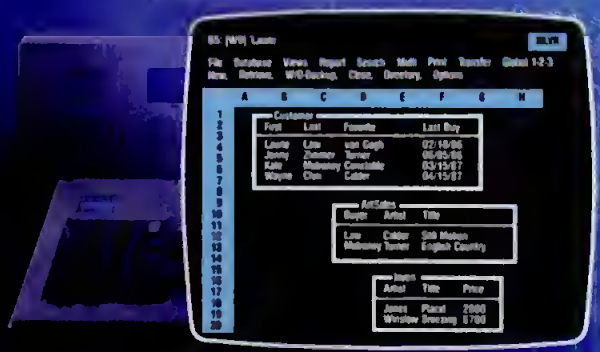


Hit a few keys—see Sales by Product



Hit another key—see Sales by Region



Windows present data from multiple databases

Hit another key—see Sales by Month

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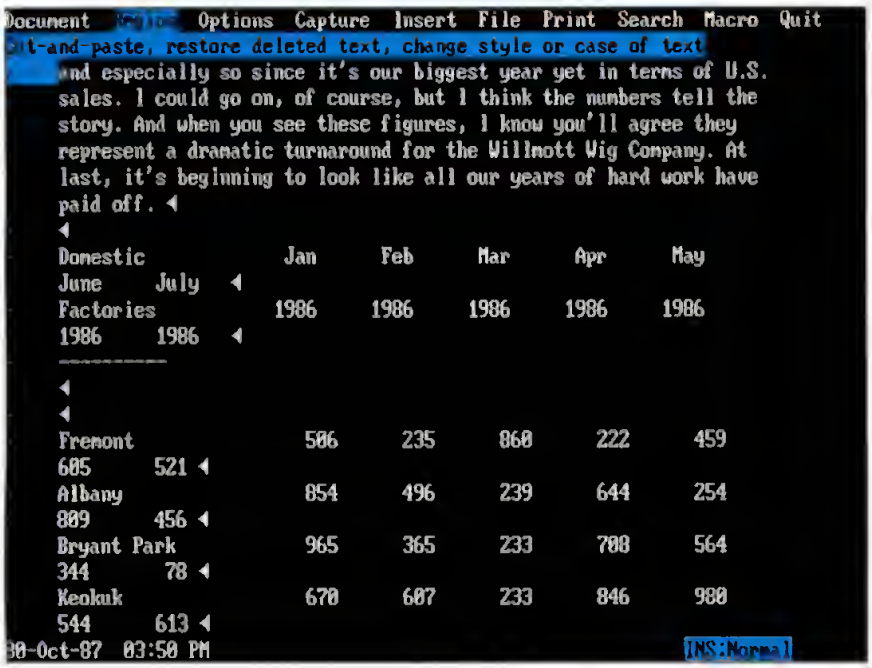

Write-in's working area isn't part of a 1-2-3 *worksheet, and documents are saved in a separate file. But the program interacts with* 1-2-3, *and commands will be familiar to* 1-2-3 *users.*

gram than do its competitors. *Write-in* feels more than anything else like a miniature version of *Microsoft Word*—with such features as simplified style sheets and macros for boilerplate and repetitive commands.

When invoked, *Write-in* replaces the row-and-column spreadsheet screen with a conventional WP-like display. Filename, cursor position, text enhancements, and paragraph formatting (if any) appear in the first of two highlighted lines of a "control panel" across the top of the screen, with a traditional WP-style ruler line filling the second line. The *1-2-3* date and time indications appear in the usual places at the lower-left-hand corner of the screen; *Write-in* adds an Insert/Overwrite indicator at bottom right. Otherwise the screen is clear, and you've got 22 80-character lines within which to work.

GOING OUTSIDE THE .WK1 *Write-in*'s different approach to creating and saving text is underscored by this attractive, uncluttered screen. *Write-in*'s working area isn't part of a *1-2-3* worksheet. And your text isn't saved in a *1-2-3* .WK1 file, but in a separate file. However, the program interacts directly with *1-2-3*'s code and structure, and the commands and approach will be familiar to *1-2-3* users. *Write-in*'s Lotus-like moving-bar menu is called, as in *1-2-3*, by striking the Slash key: if you want the slash character in your text, just type Ctrl-Slash, and menu choices are made as in *1-2-3*. For assistance, hit F1 for help screens that are usually but not always context-sensitive. (If *Write-in* can't tell just what you need help with—and it isn't terribly smart about that—it shows a Help Index, and you can choose the relevant topic manually.) A nice touch: you can hit F1 for help even in the middle of a command sequence, then drop back into the command and finish it, guided by the terse but excellent help screens.

The program divides documents logically into page headers, page footers and body text. The control panel always tells you which part of the document you're working in. You'll see headers and footers on-screen only while entering or editing them, and multiline entries are possible in both, up to a limit of 255 characters in each. Entry and editing of text are conventional, with a full complement of navigational shortcuts for jumping forward or backward by characters, words, lines, paragraphs, or screens.

STYLE SETTING Much of *Write-in*'s power and convenience comes from its mini-style-sheet feature, which lets you create, store, edit, use and reuse up to 20 different paragraph styles and up to 15 different character styles. Paragraph styles cover such things as left, right, and center justification, line spacing, paragraph indentation and first-line indents (to save tabbing-in at the start of every paragraph). For easy recall and reuse with other files, paragraph styles can be saved in libraries apart from the documents within which they were first created.

Character styles include not only the usual normal, italic, bold, and underline, but also superscripts and subscripts, strikeover and combinations such as bold underlined italic text. Applying paragraph and character styles to your text is fast and easy.

Saving and retrieving text uses *Write-in*'s versions of the *1-2-3*/File Save and /File Retrieve commands. Text is saved outside the worksheet, in files with .BLT (for Blossom textfile) extensions. *Write-in* also automatically creates BACKUP.BLT and BACKUP.BLM files when you end a session, saving backups of both your most recent version of the document and also of any macros you created during that session.

■ *Write-in* makes good use of macros: it lets you write and save them within a learn mode.

Write-in's reliance on style sheets appears again at print time. The program includes a small library of predefined print (or page) styles, the default among which is chosen automatically when you begin a document. Print styles cover paper size and width, margins, and header/footer management. You can choose from

among the print styles supplied, add to them, or make up your own print-style libraries.

Printing the document requires a Lotus-like /Print Print Go keystroke sequence (with no Align command). You can also get a preview of how the finished document will look, sans all on-screen formatting marks, by selecting /Print Display. Like *4Word*, *Write-in* uses *1-2-3*'s own print drivers, output quality is limited by those drivers' shortcomings. For example (unlike *InWord*), *Write-in* and *4Word* cannot handle proportionally spaced type or downloadable soft fonts.

INTEGRATING WORKSHEETS The ease with which *Write-in* can snatch a patch of spreadsheet data and paste it into the middle of your document illustrates the advantages of its approach—that is, working *with* *1-2-3*, not only *within* a single worksheet.

To capture data, first enter the text for your document. When you get to the point where you want the worksheet data inserted, just tap /Quit, then use *1-2-3*'s /File Retrieve commands to load the worksheet containing the range you want to include in the document. Hit the Alt-key combination you've assigned to *Write-in* and you're back in word processing mode.

Move the cursor to the point at which you want the worksheet patch inserted. Choose *Write-in*'s /Capture Linked command. You'll instantly see the *1-2-3* worksheet on-screen, but with *Write-in*'s Capture menu in place of the usual *1-2-3* menu. Anchor the first cell of the range you want with a period; drag the highlighting over to the last cell of the range and hit Enter. You're instantly back in your WP document, and the spreadsheet range has automatically been inserted in the right place.

As with *4Word*, you can then use the usual italic, bold, and underlining text enhancements on all or part of the captured worksheet range for clarity or emphasis.

Mail-merging uses *1-2-3* databases in a manner similar to that used by *4Word*. But again, *Write-in*'s ability to go out, read-in a *1-2-3* worksheet, and allow you to select the merged fields directly from a separate spreadsheet file makes the job quicker and easier than with *4Word*. *Write-in* will also serially number your merged documents if you wish.

Write-in makes exceptionally good use of macros: it lets you write and save them within a learn mode. These are *Write-in* macros, not *1-2-3*-style macros, which means they're much easier to create and understand. Macros are limited to 80 keystrokes.

You can save your macros in libraries (with up to 49 macros per named library), and you can have an unlimited number of macro libraries available. A basic macro library comes with the program; these macros use mnemonic Ctrl- and Alt-key commands for common functions, such as Alt-i to select the italic character style.

GRAPHICS, PLEASE *Write-in* can merge graphics and text on the same page, but does so about as clumsily as *4Word*'s *4Graph*, relying in the end on the *1-2-3* PrintGraph routines. You're going to have to really *want* merged graphics and text to produce them with either of these programs.

Overall, *Write-in* is the richest, most versatile, and satisfying WP add-in with which to work. Its feature-set is larger, and the implementation of those features is generally cleaner and better thoughtout than with either *4Word* or *InWord*.

Write-in offers more "real word processing program" features than does its competition—and sometimes implements these features even better than do standalone WPs. For example, *Write-in* manages block moves, copies, and erases with a /Region command set. If you use /Region Delete to kill a block of text, that text is saved in a buffer that holds your last *ten* block deletions. You can roll back through that undo buffer, looking at the first few words of each, then restore any of those deletions with a simple /Region Insert Use command. Very nice—and why can't I have that kind of intelligence on my regular word processing program?

Write-in is somewhat slower to respond to keyboard input than other WP add-ins, but few users of these products are likely to be high-speed power typists, so overrunning the input buffer shouldn't be a problem. While secretaries and other true power users of word processing software won't be tempted by *Write-in*, the manager or executive who wants to knock out more than the occasional short letter or memo—and who may be a bit spoiled by having used a good standalone WP program—will find *Write-in* an excellent choice.

—Jim Seymour

Note-taking PROGRAMS

Word processing add-ins are good choices for full-fledged memos and other documents, but for spreadsheet annotation, you need a note-taking program. Note-takers work like Post-its for your *1-2-3* spreadsheets; they're great for appending notes about a formula or range of cells, and for workgroup spreadsheeting where different users need to add their comments to a single worksheet. Two veteran standalone *1-2-3* note-takers, *Note-It Plus* and *Noteworthy*, have been adapted to work with the Add-in Manager, giving you note-taking capabilities right inside *1-2-3*.

Note-It Plus

Great families don't always stay great. Turner Hall Publishing's $79.95 *Note-It Plus* is the grandson of *Note-It*, the pioneer *1-2-3* annotation package, released in 1985. The original *Note-It* let you write brief notes that explained or commented on any cell in a spreadsheet, and users

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Note-It Plus
Turner Hall Publishing
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600
List Price: $79.95
Requires: 70K RAM, *Lotus 1-2-3*, Release 2.0 or later.
In Short: An overelaborate and sometimes undereffective notation system for *1-2-3*. Not copy protected.

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Note-It Plus *lets you annotate your worksheets with notes of up to 500 characters. You can perform searches of all the notes in a spreadsheet or directory, and print cells with their notes.*

loved it. The first *Note-It* begat the more ambitious Version 2 a year later. Both versions were slightly unruly RAM-resident programs that had trouble coexisting with other applications. Now the third-generation version, renamed *Note-It Plus*, has appeared. It's no longer a TSR. Instead, it meekly attaches itself to *1-2-3* via the Add-In Manager. It's extremely well behaved and has plenty of new tricks to show off. But it no longer stands above its latecomer rivals, such as *Noteworthy*.

Note-It Plus sports some unique and luxurious features. It lets you search for text in its notes, in the current spreadsheet, and in all spreadsheets in the current directory. You can print out a note and the cell that goes with it. You can remind yourself what's in a spreadsheet by creating "file notes." And you can see these by pressing a hotkey when the highlight is on any of the filenames in the directory that *1-2-3* displays when you enter the /File Retrieve command. All notes display the date they were last revised.

Once you're working in a spreadsheet, you can press a second hotkey to bring up a menu from which you can edit a note or perform other note-management and search functions. Or you can skip the menu by pressing a third hotkey that opens a note window for the cell under the highlight. The three hotkeys use the Ctrl, Alt, and Shift states of the same function key, so they're easy to remember. When you display a note, one key lets you toggle between it and the spreadsheet underneath.

The editor in *Note-It Plus* is nothing to write home with or about. It can't reformat

■ You can customize *Noteworthy*'s memory usage and even modify its screen display.

paragraphs automatically. Its block moves use *WordStar*'s clumsy Ctrl-K commands. This won't daunt anyone who learned *WordStar* in the days of steam-powered computers. But today, when most computer users have never seen *WordStar* and wouldn't want to, the editing commands in *Note-It Plus* seem arbitrary or worse.

Almost anything on the menus requires too many keystrokes. When you use the menu option to highlight all cells with notes attached, you have to go back to the menu to remove the highlights.

You're limited to 250 notes of 500 characters each. The manual suggests that you can create longer notes by "linking" one note to another. But linking is an awkward process, and if you want the second note to continue the first, you have to attach it to a cell that you won't want to annotate on its own. To read through linked notes, you use a Browse command that works only in a forward direction.

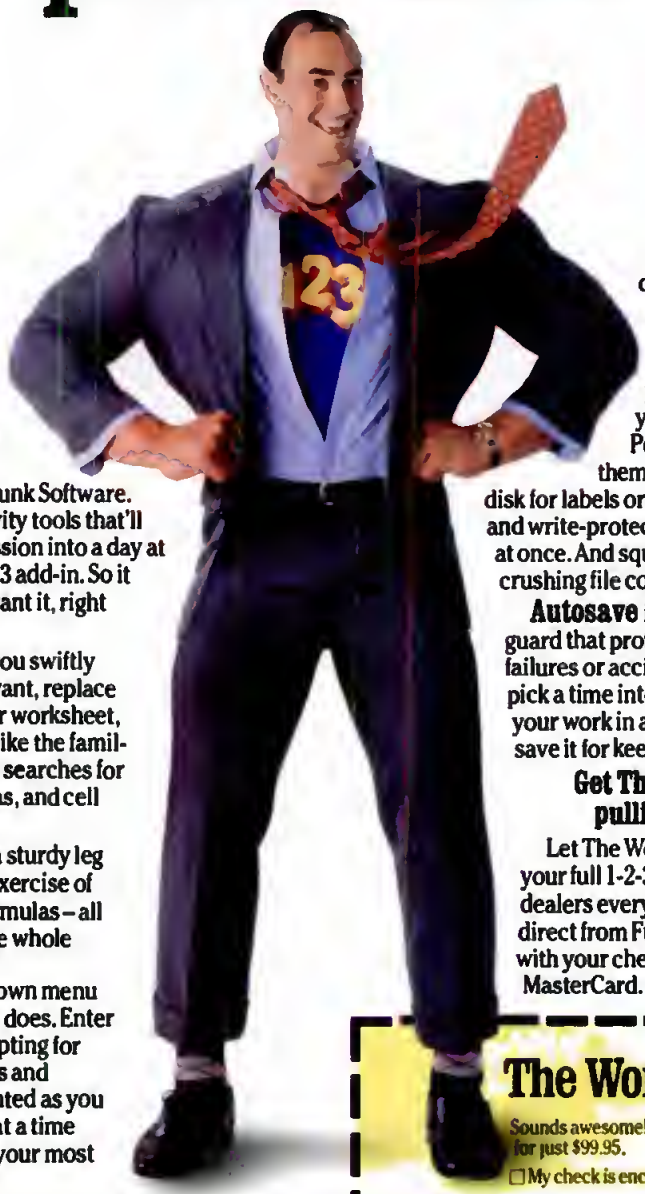
The help screens are context sensitive, but there are no keywords or cross-refer-

Note-taking Programs: Summary of Features

	Note-It Plus $79.95	Noteworthy $79.95
RAM requirement (above 1-2-3)	70K	50K
LIM EMS supported	Version 3.0 and 3.2	LIMspec 4.0
Note limit	250 notes	No limit
Seerches through worksheet	●	○
Can change size of note window	○	●
Imports text file	○	●
Can cut-and-paste within worksheet	●	●
Sevee notes in 1-2-3 file or outside	●	○

● — Yes ○ — No

Now you too can be a 1-2-3 power user.



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Search and Replace lets you swiftly search for one thing, and if you want, replace it with another – throughout your worksheet, or in ranges you specify. It's just like the familiar word processor feature, yet it searches for labels, values, functions, formulas, and cell references, too.

Formula Editor gives you a sturdy leg up in the otherwise exhausting exercise of writing and testing your 1-2-3 formulas – all from a display that shows you the whole formula, not just 80 characters.

Pick @functions from a pull-down menu that explains what each function does. Enter arguments with on-screen prompting for each argument. See syntax errors and unmatched parentheses highlighted as you edit. Execute formulas one step at a time for quick, painless debugging of your most monstrous, complex creations.

Print Settings takes the guesswork out of print formatting. See all your margins, headers, footers, and other options on a single display. Create different settings for different print jobs and call them up by name.

Select any print style you like from a library of setup strings customized for your printer. Forget complicated printer codes. Each setup string has a name, like "17 pitch" for your Epson, or "Landscape mode" for your LaserJet.

File Manager gives you a powerful grip on the organization of all your worksheets and other files on your disk.

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Funk Software, 222 Third Street, Cambridge, MA 02142

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ences, so you have to page up and down through the help file to find out about other topics. You may need the help file, because the program's many options don't always use intuitive names. The well-designed tutorial covers the basics of the program, but you'll have to browse through the manual for the advanced features.
—Edward Mendelson

Noteworthy

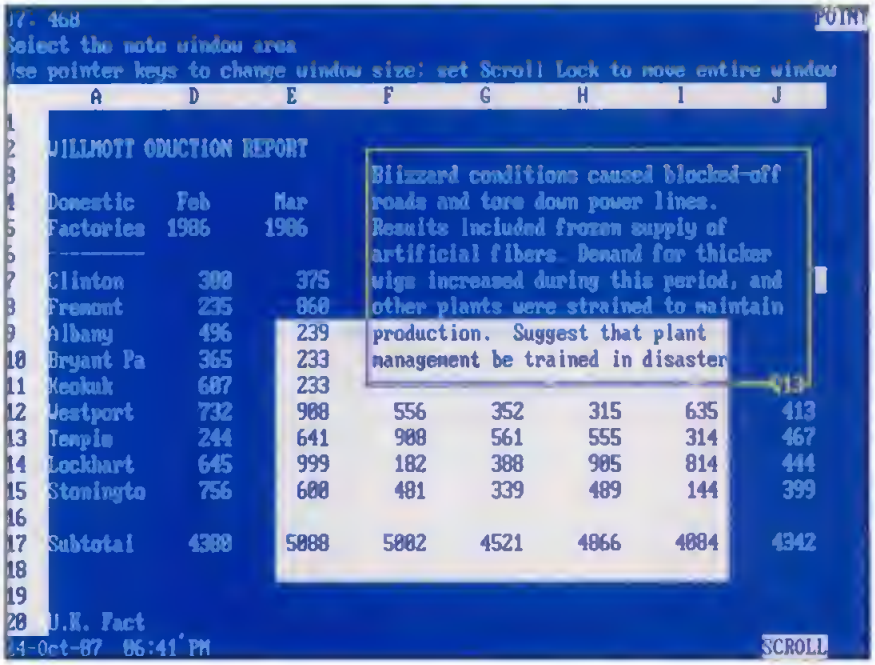
The packaging and manual of Funk Software's *Noteworthy* look, well, a bit funky, but the program is as elegant and intuitive as the best high-tech design. This $79.95 annotation program fits seamlessly into *1-2-3* through the Add-In Manager and also shoehorns its way into *Symphony* without much strain. If it doesn't have all the features of its rivals, it has all the essentials and implements them remarkably well. It's one of those rare programs that's designed to make matters easier for the user rather than to show off the skill of the programmer.

Nothing could be easier to use than *Noteworthy*. When you reach a cell you want to annotate, just press the hotkey and a window opens for editing. The editor works like any good word-processing editor, complete with a search-and-replace function and easy-to-use block manipulations. There's no limit on the size or quantity of notes, and you can easily import a text file into a note or merge a different note file into the current one. A paste buffer lets you transfer text or formulas from worksheet to notes and back again. You can copy individual notes to a whole range of cells.

Whenever you create or edit a note, a function-key menu either gives you instant access to a list of notes or highlights all annotated cells in the worksheet. Another function key takes you to a menu of advanced options. The help screens use the same cross-referencing system used by *1-2-3* itself. *Noteworthy* stays alert even when you don't invoke it with its hotkey. If you move the *1-2-3* highlight to a cell that has a note attached, a note indicator lights up at the foot of the screen.

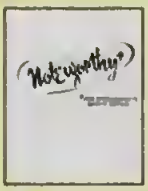
You can customize *Noteworthy*'s memory usage and even modify its screen display. You can change the size of the note window to something unobtrusive and move the window into a little-used corner of the screen. *Noteworthy* is also smart enough to use Lotus/Intel/Microsoft expanded memory specification and frugal enough to use no more disk space than it absolutely needs.

You don't get file notes with *Noteworthy* and you don't get searches through the worksheet itself. But you get clarity, ingenuity, and efficiency.
—Edward Mendelson



Noteworthy has a full-featured editor and a buffer for transferring data between notes and worksheet. Note that windows can be sized and moved, and there's no limit on note size or number.

PC MAGAZINE FACT FILE



Noteworthy
Funk Software
222 Third St.
Cambridge, MA 02142
(800) 822-3865
(617) 497-6339
List Price: $79.95
Requires: 50K RAM; *Lotus 1-2-3*, Release 2.0 or later.
In Short: The simplest, most effective, and most customizable way to attach notes to spreadsheets. Not copy protected.

CIRCLE 668 ON READER SERVICE CARD

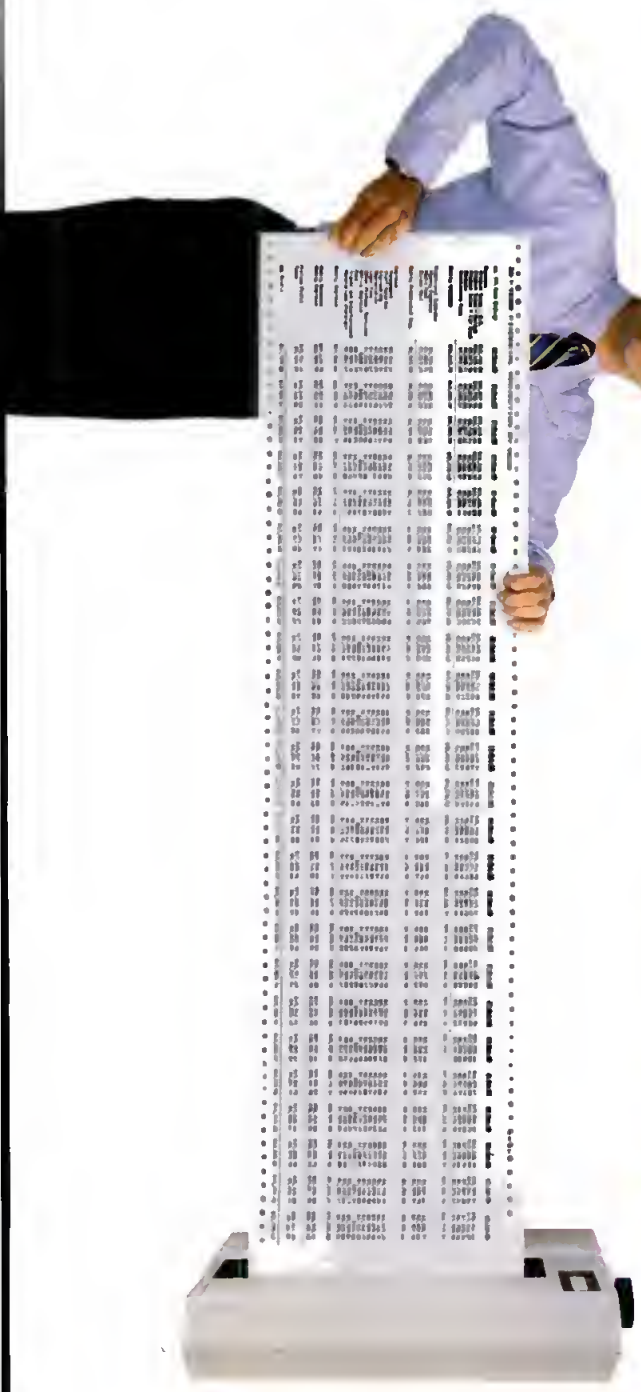
Database Management ADD-INS

Though not primarily designed for data management, *1-2-3* is one of the most widely used programs for database work. And that makes sense, if most of your work involves spreadsheets, you use *1-2-3*, and if you're using *1-2-3* most of the time, why should you switch programs when it's time to perform occasional database tasks?

But use a *1-2-3* database for a while, and you'll quickly notice there's a lot of room for improvement. The worksheet display is the only data entry screen you've got, sorting functions are minimal, and reporting features are, well, rudimentary.

Add-ins to the rescue. Try *Data Manager*, *Informix Datasheet Add-In*, and some of the other DBMS products for sorting and reporting. And for original data entry of file imports from DBMS programs,

Funk Software continues to forge Sideways.



Let Sideways take your printouts to new widths.

Each day, more people turn to Sideways® for printouts of nearly everything that's too wide for a printer. No wonder.

Nothing's as fast or easy. And nothing makes great-looking one-piece printouts that go on this wide. So you get spreadsheets that really spread out. Pert charts that peer far into the future. All kinds of extra-wide printouts without staples, glue or tape. And the newest Sideways makes even shorter work of those wide 1-2-3® printouts.

New Sideways version 3.2 runs right inside 1-2-3.

Sideways now works as a full-fledged add-in to 1-2-3 release 2. As well as Symphony.® So the instant you're done creating your spreadsheet, you're ready to print with Sideways. Right from your Lotus session. Just select Sideways from your Lotus menu, highlight a range and print.

Mix bold, underlined and italic type, all on the same page. Print through or skip over perforations. Add borders, change page size, adjust margins any way you like. And do it all from Sideways menus that look and act just like Lotus itself.

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New Sideways Version 3.2 for the IBM® PC and all popular dot matrix printers, as well as the LaserJet Plus/Series II. Available at software dealers nationwide, or directly from Funk Software with your check, Visa or MasterCard.

More than ever, Sideways is the only way to go.

Special Upgrade Offer!

Just send us your current Sideways program disk along with $20. We'll send you new Sideways version 3.2 right away.

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☐ Please send me _____ copies of new Sideways version 3.2 at $69.95 each.
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My current Sideways program disk is enclosed.
☐ My check is enclosed. Charge my ☐ Visa ☐ MasterCard

Account number _____ Exp. date _____

Name _____

Company _____

Address _____

City _____ State _____ Zip _____

To order call 1-800-822-3865, Ext. 115
(617-497-6339 in MA)

New Sideways version 3.2 works with all releases of 1-2-3 as well as other software. Add-in capability requires 1-2-3 release 2 or Symphony.

Funk Software, 222 Third Street, Cambridge, MA 02142

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Database Management Add-ins: Summary of Features
(Products listed in ascending price order)

	Data Manager $79.95	D.A.V.E. $99.95	Fetch.* $99.95	Daja $129.95	Informix Dataahaet Add-in $199.95
RAM requirement (above *1-2-3*)	50K	60K	60K	60K	640K
LIM EMS supported	LIMspec 4.0	LIMspec 4.0	LIMspec 4.0	LIMspec 4.0	LIMspec 4.0
Import export					
Symphony files	○	○	●	○	○
dBASE files	○	○	●	●	○
R:base files	○	○	●	○	○
Reflex files	○	○	●	○	○
Data Manipulation					
Creates file description tabls automatically	●	●	●	○	○
Can filter subsets of data	●	●	●	●	●
Graphs database data with *1-2-3* functions	●	○	●	●	●
Can customize field help messages	○	●	○	●	○
Can customize data entry screens	●	●	○	○	○
Applies validation criteria to existing data	●	●	●	●	●
Allows use of wildcard in searches	●	○	●	○	●
Uses SQL language to achieve relational characteristics	○	○	○	○	●
Reporting Capability					
Reports subsets of sorted data	●	○	●	○	●
Can customize report forms	○	●	●	○	○

●—Yes ○—No

check out Manusoft's *Fetch.**. A combination of these products can work wonders for your *1-2-3* databases.

Data Manager

Lotus 1-2-3's data management functions have always been among the most complex and daunting of the program's elements. Many a longtime *1-2-3* user—proficient in all the program's mathematical, financial, and statistical functions, and even with *1-2-3*'s command language—will begin to mumble and attempt to change the subject if asked about horizontal look-up tables or criterion ranges.

In addition, while *1-2-3*'s data-management functions are natural candidates for use within data-entry-type user applications, they have been underused in many quarters, due largely to the complexity of programming in the *1-2-3* macro or command language, and the ease with which unskilled users can crash the typical macro-based application and unwittingly overwrite or erase a range of data or even the application code itself. There are ways around most of those problems, but still, it's always been easier to give an unskilled user a copy of a more-bulletproof database-management program, such as *PFS:File*, than to construct an application in *1-2-3* with enough error-handling capability to take on a novice user.

Data Manager, from Intex Solutions, attempts to rectify this situation by being a *1-2-3* data entry and access system that uses attractive data entry forms and offers features such as validation ranges and calculated fields.

In one sense, *Data Manager* doesn't bring a whole lot in the way of new functionality to *1-2-3*. In fact, almost everything you can do within *Data Manager* could be achieved with a macro-driven program—but nowhere near as easily. *Data Manager*'s $79.95 price may well be justified simply by the ease with which it allows you to set up new data entry screens, by the built-in error-checking functions it provides, and by the polished, finished appearance of the data entry screens you can create with it.

Setting up a new database using *Data*

What's friendly, powerful and remembers everything about your 1-2-3 spreadsheets?

With Noteworthy, neither you nor others who use your spreadsheets need ever forget the true meaning of a cell.

It's a jungle in there.

Let's face it. Some of your spreadsheets can be real beasts-with tons of formulas, assumptions, and complex interrelations between cells.

It's tough enough trying to remember your own reasons for doing things. Worse yet, try explaining it all to someone else.

Introducing Noteworthy—The professional spreadsheet annotator.

Now, thanks to new Noteworthy,™ it's easy to tame the most gigantic spreadsheets in creation. That's because Noteworthy is the first software ever to combine a majestic power for spreadsheet annotation with a gentle, cooperative nature.

Plus, it works alongside 1-2-3® in a way that no software has ever done before.

Want to remember why you put what you put in a cell? Just hit the hot-key and up pops a blank note. Then type away using Noteworthy's powerful built-in editor (it will remind you a lot of a full-featured word processor).

Create single notes up to 8,000 characters long. Make as many notes as you need, in a window of any size you choose, positioned on the screen where you want. Copy text from your note to a spreadsheet. From your spreadsheet to a note. Or from one note to another. Find and replace words and phrases automatically, in single notes, or throughout the spreadsheet.

Noteworthy even reminds you where you put your notes. Each time the cursor lands on an annotated cell, the note indicator lights up at the bottom of the screen.

Big news for heavy 1-2-3 users.

Despite its awesome power, Noteworthy is fast and reliable. That's because it doesn't lumber along in the background like some RAM resident utility. Instead, it runs as a bona-fide 1-2-3 add-in. In fact, Noteworthy was specially developed using new software tools supplied by Lotus® themselves.

That means true integration between 1-2-3 and Noteworthy. No clumsy interference with the keyboard or with background programs like SideKick.® And it consumes less than 50K, which means it virtually runs on peanuts.

So why burden yourself with the details of your spreadsheets, or with annotation software that doesn't pull its weight? Just remember Noteworthy. And you can forget everything else.

Look for Noteworthy at computer dealers on several continents. Or avoid the stampede and order direct from Funk Software with your check, Visa or MasterCard.

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To order call 1-800-822-3865, Ext. 115

(617-497-6339 in MA)

Requires 1-2-3 Version 2 or Symphony.® Will not run with 1-2-3 Version 1 or 1A.

CIRCLE 321 ON READER SERVICE CARD

Funk Software, 222 Third Street, Cambridge, MA 02142

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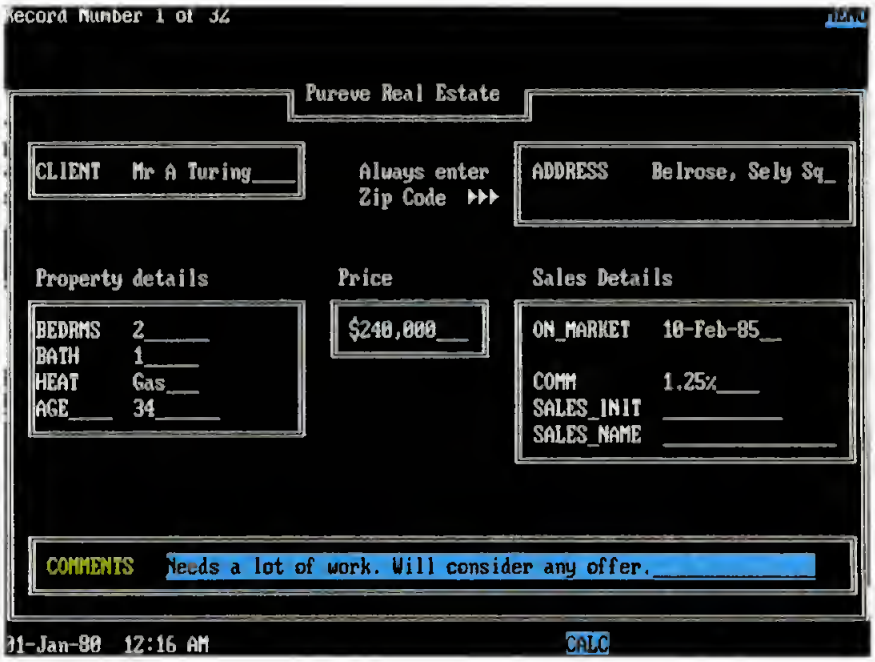
Manager and *1-2-3* couldn't be easier. You simply enter the field names to be used in the database across row 1, starting in A1. Then you invoke *Data Manager*—at which point it will automatically generate a data entry screen consisting of the field names you've entered, listed down the left hand side of the screen.

You can enhance the appearance of the initial data entry screen created by *Data Manager* by moving fields around the screen, drawing boxes around fields, or entering descriptive text or even a field's name on-screen. You can also change the width of a field and the format in which it is displayed. (*Data Manager* supports all the standard Lotus display formats: currency, date, time, fixed, scientific, and so forth.)

Fields can also be deleted from the data entry screen. This does not affect the field's data in the worksheet, and, as a result, a deleted field can be restored at any time. You can also create new fields while working with the data entry screen—doing so results in a new field name being added to the underlying Lotus worksheet.

Once you're satisfied with your *Data Manager* data entry screen, you can create validation rules for fields, then begin adding data and working with your database.



Data Manager *makes it easy to create polished data entry screens with built-in error checking. You can move fields around the screen, draw boxes around fields, and enter descriptive text.*

FIELD AND RANGE CHECKING *Data Manager* supports several types of field validation or checking. For instance, you can specify a default value for a field, consisting of a text string, number, date, or formula. When there is a default value for a field, the person entering data into the database has the option of accepting the default or entering new data into the field.

Another *Data Manager* option, the field formula, allows you to create a pure calculated field that cannot be changed by the data entry person. You can also specify whether the formula you enter is to apply to all records in the database or only to all new records. This allows you to change the formula used to determine the value of a field in an existing database without changing the value of that field in existing records. So, for instance, the formula field that determined a salesman's commission could be changed to reflect a new commission rate without changing the value that appears in the commission field in existing records calculated according to the old rate.

Data Manager also supports range checking with its Check command, which prompts you to enter a formula that will always be true when valid data is entered into a field. You could, for instance, use the Check command to determine that the commission being paid on a sale is within your firm's upper and lower limits, or (by using *1-2-3*'s table lookup function) to determine that the customer number entered on an order belongs to a valid customer, and that the customer's approved credit line will cover the amount of the order.

DATA ENTRY Data entry with a *Data Manager* entry form is a simple matter of typing data into a field and pressing Return to move to the next field. You can back up if you wish, and you can easily edit previously entered data.

Once your database is in use and you've entered some records, you can search for data using *Data Manager*'s Query command by entering a logical formula such as INVOICE#=1546 to find a specified record. You can also search for text in the database by highlighting a database field and then indicating which text you wish to find. *Data Manager* supports the use of a wildcard (*) character, so that you can specify inexact strings. For instance, if you knew the exact spelling of Mr. Smith's last name, you could enter Smith into the Last_Name field to find his record, but if you didn't you could enter Sm* to find *Smith* or *Smythe*, or *Sm to find *Harcourt-Smith*, or

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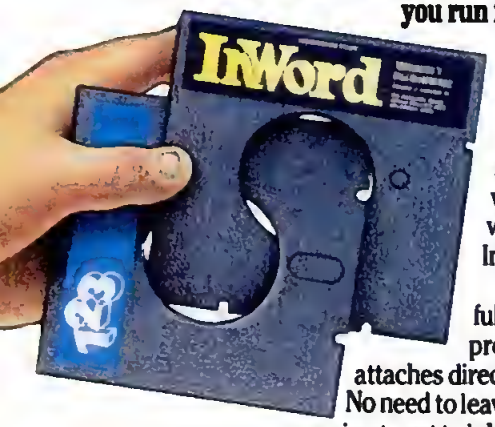
Data Manager
Intex Solutions
568 Washington St.
Wellesley, MA 02181
(617) 431-1063
List Price: $79.95
Requires: 64K RAM; *Lotus 1-2-3*, Release 2.0 or later.
In Short: *Data Manager* is an easy-to-use and complete tool for creating and manipulating new worksheet-based databases. Among its strong points are its formatted data entry screens and its provisions for range checking, table lookups, and field validation. Not copy protected.

CIRCLE 880 ON READER SERVICE CARD

Now there's a real word processor that's just as attached to 1-2-3 as you are.

Introducing InWord. The complete word processor you run from inside 1-2-3.



Now, for everyone who's ever formed a meaningful relationship with 1-2-3,® we offer a single word of advice – InWord.™

It's the full-fledged, full-function word processor that attaches directly to Lotus 1-2-3. No need to leave your 1-2-3 session to get to InWord. No need to leave InWord to get back to 1-2-3.

Best of all, InWord works wonders with your words in the same way 1-2-3 helps master your math.

Take full command of the language.

InWord is equipped with the kind of speed and performance that anyone could fall for. You get automatic word wrap and paragraph reform, horizontal scrolling, search and replace, cut and paste, cursor movement by word, sentence or paragraph. And there's more.

You can format your document with headers, footers, page numbers, tab stops, indents, and hanging indents. As well as left, right, center and full justification.

Plus you can print bold, underlined and italic text, and mix typefonts and pitch to your heart's content.

InWord gives you instant spreadsheet integration, plus powerful formatting and typestyle controls.

It's great to be connected with Lotus.

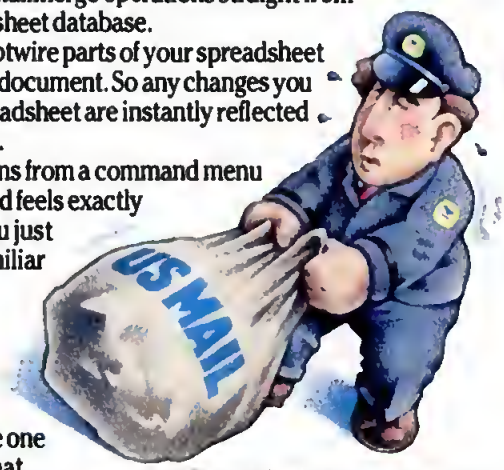
It's no coincidence that InWord gets along so beautifully with 1-2-3. In fact, InWord was developed especially for 1-2-3 Version 2 using software tools supplied by Lotus® themselves.

That means InWord is truly integrated with 1-2-3. So it's a breeze to transfer data directly from a spreadsheet to a document, or the other way around. And a snap to do lightning-like mailmerge operations straight from your 1-2-3 spreadsheet database.

You can even hotwire parts of your spreadsheet directly into your document. So any changes you make to your spreadsheet are instantly reflected in your document.

Plus, InWord runs from a command menu that looks, acts and feels exactly like 1-2-3 itself. You just can't get more familiar than that.

So if you've become hopelessly attached to the 1-2-3 habit, insist on the one word processor that shares your affection. InWord. It's from the makers of Sideways, the world's leading 1-2-3 spreadsheet printing software.



With InWord, automatic mailmerge is as easy as selecting a range from your 1-2-3 spreadsheet database.

See InWord at better computer dealers everywhere. Or order direct from Funk Software with your check, Visa or MasterCard. At just $99.95 a copy, InWord could be the last word you'll ever need.

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To Order call 1-800-822-3865, Ext. 115

(617-497-6339 in MA)

Requires 1-2-3 Version 2. Will not run with Version 1 or 1A.

Funk Software, 222 Third Street, Cambridge, MA 02142

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CIRCLE 311 ON READER SERVICE CARD

Sm to find *Harcourt-Smythson*.

Finally, *Data Manager* also has the ability to sort your data using up to four sort keys (in ascending or descending order). Unfortunately, one feature lacking in *Data Manager* is the ability to print reports based upon your searches and sorts. Of course, you could always print the raw data in your database by returning to *1-2-3*, but *Data Manager* doesn't offer you any way to print sorted reports of subsets of your data.

Nevertheless, unless you need that kind of report generation capability, *Data Manager* would be a good choice for any new worksheet-based databases you wish to create. From start to finish it is an impressively easy-to-use product. However, it does suffer from inflexibility. For instance, because it requires all field names to appear in row 1 of your worksheet, starting at cell A1, and because it adds data to the worksheet starting in row 2 for the first record in the database and working downward, it cannot be used with existing *1-2-3* databases and, thus, falls short of being the complete answer to making data management in *1-2-3* entirely bearable. This would also seem to prevent it from being used in conjunction with a product such as *Fetch*.*, which would allow the user to store the database on-disk outside of a worksheet file.

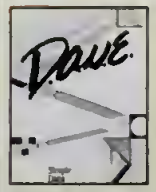
Data Manager would benefit greatly if it were modified to allow the user to specify the range in which it should look for field names, and the range in which it should look for and enter data.

—B. G. Waldman

D.A.V.E.

D.A.V.E. from Goldata Computer Services, is unique among the database add-ins reviewed here for its quirky integration with *1-2-3*'s data query commands. It leaves more basic database functions to *1-2-3* than do any of the other add-ins reviewed here, and yet it also replaces other

PC MAGAZINE FACT FILE



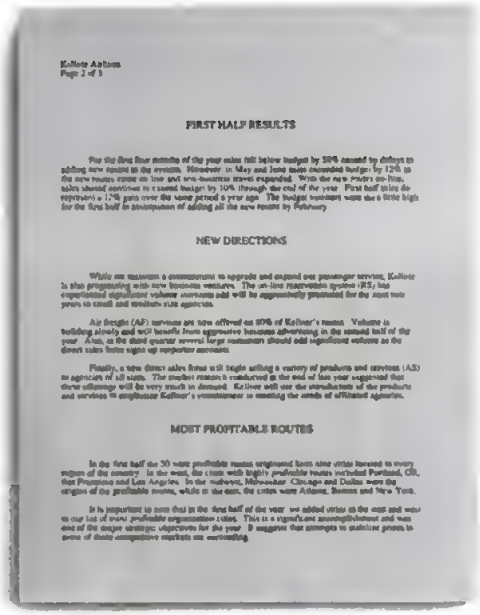
D.A.V.E.
Goldata Computer Services Inc.
2 Bryn Mawr Ave.
Bryn Mawr, PA 19010
(800) 432-3267
(215) 525-1036
List Price: $99.95

Requires: 64K RAM; *Lotus 1-2-3*, Release 2.0 or later.

In Short: *D.A.V.E.* adds a host of powerful screen design, data verification, and report generation capabilities to *1-2-3*'s array of database functions. It is an invaluable tool both for creating new databases and for working with existing ones. Not copy protected.

CIRCLE 059 ON READER SERVICE CARD

Maybe it's not what you're saying that's so dull.



FIRST HALF RESULTS

NEW DIRECTIONS

MOST PROFITABLE ROUTES

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1-2-3 functions more completely than do any of the others.

Happily, there is method in *D.A.V.E.*'s madness. It becomes obvious very quickly when you work with *D.A.V.E.* that somewhere along the line its (his?) makers sat down, took a good look at *1-2-3*'s data query commands, and said, "Hey, there are some things—queries and sorts, for instance—that *1-2-3* is really good at. We'd be wasting our time to try to replace those. Instead, we'll concentrate on the things that *1-2-3* could use some help with: Data Addition, Verification, and Editing." Hence the acronym.

Their strategy was a wise one. While *D.A.V.E.*'s database functions are nowhere near as self-contained as those of some other database add-ins, the ones that it does provide—polished, versatile data entry screens; powerful data-validation tools; flexible report-generation capabilities—possess a richness or robustness beside which most other add-ins pale. And while *D.A.V.E.*'s failure to duplicate some of *1-2-3*'s data-query commands means that a bit more command language programming is required to create a full-fledged database application with *D.A.V.E.* than with other database add-ins, *D.A.V.E.*'s modular quality also means that its data entry, verification, editing, and reporting functions can be used ad hoc in almost any *1-2-3* application—not just for canned database entry applications.

■ *D.A.V.E.* can apply the validation criteria you enter to existing data through its verify option.

D.A.V.E. actually consists of two modules or components. One, as expected, is a *1-2-3* add-in that gives access to *D.A.V.E.* functions at any point during a *1-2-3* session. The other is a standalone Image Definition Module that is used to create data entry or report screens, to set up field-verification criteria, to enter customized field help messages, and so on.

Although most data entry screen (or image) definition and editing will take place in the Image Definition Module, you can create a simple screen from within *1-2-3*. This makes it very easy to use *D.A.V.E.* with existing *1-2-3* databases. You simply highlight the worksheet range containing the text to be used as a field name and instruct *D.A.V.E.* to create a new image. *D.A.V.E.* responds by creating a simple form listing the field names down the left-hand side of the screen. It automatically

Maybe it's just how you're saying it.

Funny thing about business communications. You may have some brilliant ideas, but if the way you present them lacks impact, your audience may never get your message.

So how do you make your presentations, proposals and memos look brilliant?

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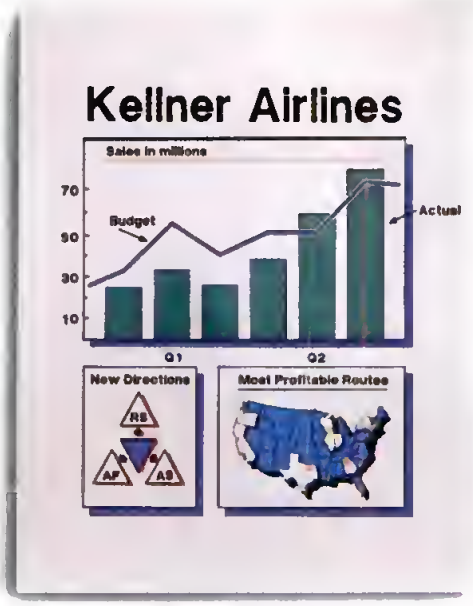
With Freelance Plus, the applications are virtually limitless—from charts to bulleted lists, maps, diagrams, drawings and more. Freelance Plus can help you create simple graphs quickly, and gives you the power to develop more sophisticated graphics as well.

Freelance Plus works with your IBM® PC and is compatible with your existing software. So you can use it to embellish charts from Lotus 1-2-3,® Symphony® or Graphwriter.®



You can mix different types of graphics on a page. Or, you can mix graphics and text on the page, when you use Freelance Plus along with the document processor, Lotus Manuscript.®

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Lotus Freelance Plus

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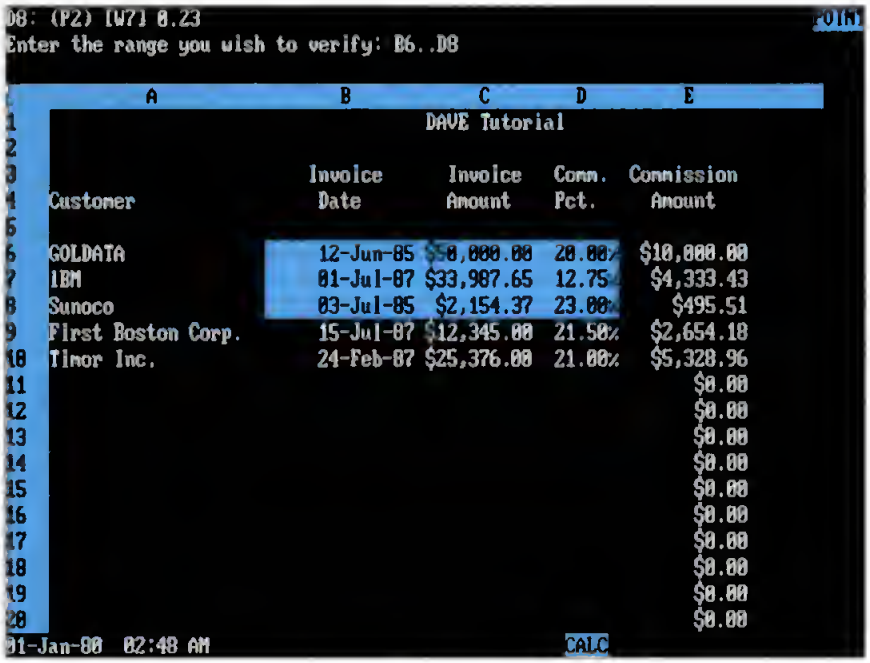

D.A.V.E.*'s verify option applies your validation criteria to worksheet data. You simply mark a section to check, and the program compares the data to your criteria, flagging any violations.*

determines the width of each field based on the width of the column from which it took the field name, and the field type (alphanumeric, numeric, date, integer) by scanning down the column from the field name and looking at the first nonblank cell.

The screen you create this way isn't much to look at, but that can be remedied easily in *D.A.V.E.*'s Image Definition Module. Of course, you have to leave *1-2-3* to do so, which seems a bit of an imposition at first, considering that all the other database add-ins manage to achieve all their magic entirely within the *1-2-3* environment. However, the richness of *D.A.V.E.*'s "images" more than makes up for this inconvenience.

IMAGE DEFINITION Within the Image Definition Module you can create attractive data entry forms and reports up to ten screens in length, working either from an image created by the *D.A.V.E.* add-in within *1-2-3* or from scratch, and using standard "paint-the-screen" techniques to arrange fields, add descriptive text, specify field type and length, and highlight areas of the screen with standard IBM ASCII graphics characters. *D.A.V.E.* provides a special "box mode" for drawing boxes around areas of the screen, as well as block move and replicate capabilities for use in editing screens.

While creating or editing a field, you must enter a unique worksheet column in which its data is to be stored. If the column you specify is already in use, *D.A.V.E.* will tell you so. You can also specify whether data entry to this field is mandatory or optional, or whether it is to be considered a display-only field showing a value from the worksheet in which data entry is not allowed. You can also specify a number of field-check criteria, including low and high acceptable values for the field (so that if 50,000 is the high boundary, any attempt to enter a higher number than that will generate an error message), and whether only unique entries will be accepted. The high and low boundaries can be specified in the form of a number or another field name (so that, for instance, End_date must be higher than Start_date), or as a cell location in which the boundary will be stored (allowing you to change the boundary number without changing the image).

D.A.V.E. can also check the validity of an entry against a small list of acceptable choices that you specify, or against a list of entries stored in an external ASCII file, or against a list of values in a named range.

Finally, you can enter a customized help message to be displayed while the user is being prompted to enter data to each field, and you can specify the order in which fields are prompted.

Returning to the *D.A.V.E.* add-in, you can use the image(s) you've created to enter new data, to generate reports, and to check the accuracy or validity of existing data. To enter new data, you simply move the cursor to the first blank row under the field names, invoke *D.A.V.E.*, and press Enter. The familiar *1-2-3* screen is then replaced by the image you've instructed *D.A.V.E.* to use, and you can move from field to field entering data. When a field has a list check, you can display the list of valid choices by pressing F3. Invalid entries generate an error message.

OTHER FEATURES One of *D.A.V.E.*'s unique features is its ability to apply the validation criteria you enter to existing data through its verify option. When selected, this option prompts you to enter a worksheet range to check, then proceeds to compare its contents to the validation criteria you've specified, identifying any violations of that criteria and giving you the chance to edit them.

D.A.V.E.'s report-generation capabilities allow you to output data to your screen or printer in the form of the currently selected image. Either way, *D.A.V.E.* will output a two-line heading and print up to five records on a page.

D.A.V.E. is not a complete database-management system. To sort your data, make queries, or perform any of a number of other data-analysis tasks, you must invoke *1-2-3*'s data query commands. However, *D.A.V.E.* brings a host of well-conceived, powerful new capabilities to *1-2-3* data management, which can be used to advantage either on an ad hoc basis or within a canned, command-language-driven application. *D.A.V.E.* could also be combined with a product such as *Fetch.** to form an extremely powerful disk-based database-management system. Unlike most other *1-2-3* database add-ins, *D.A.V.E.* was clearly designed to be as

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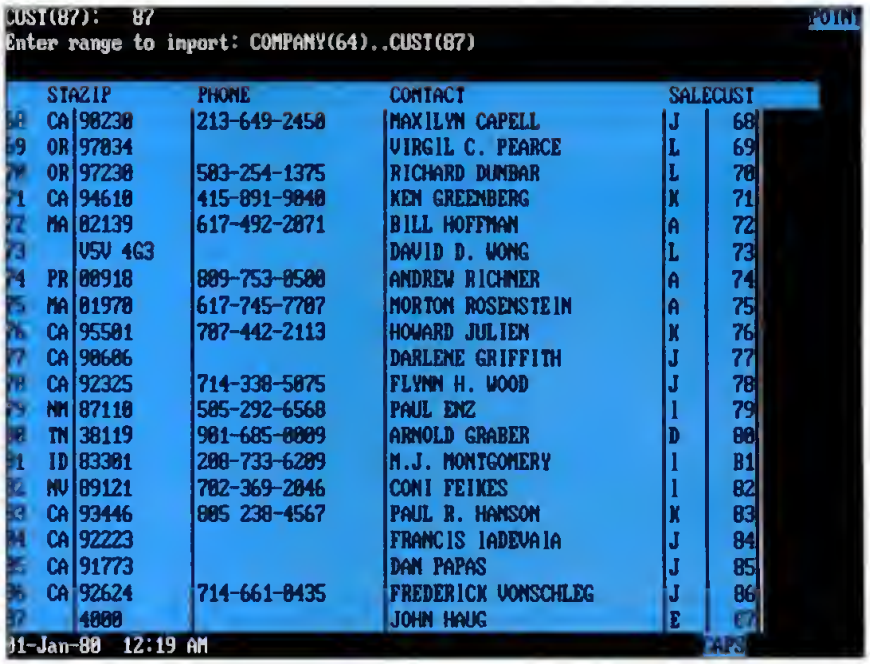
useful for working with existing *1-2-3* databases as it is for creating new ones. It is clearly a superior product.
—B. G. Waldman

Deja

One of the more constant frustrations associated with working with *1-2-3* over the years has been the Jekyll-and-Hyde nature of its database management functions. On the plus side, those functions—especially with the addition of string comparators in Release 2.0 and later—are powerful, versatile, and blindingly fast. On the minus side, worksheet-based databases tend to fill up the available memory in *1-2-3* very quickly, and the only way to get outside data into the worksheet is to go through a torturously slow import routine available only from the Lotus access menu, not from within *1-2-3*.

These limitations are bad enough when your own files grow too large to fit comfortably in a *1-2-3* database. The proliferation of departmental databases—created within programs such as *dBASE*, accessible over a LAN and all but unusable to *1-2-3*—has only exacerbated the situation.

Deja, subtitled "The *dBASE* Add-in For *1-2-3*," is Los Angeles–based PC Publishing's answer to those problems. It gives *1-2-3* users the ability to access *dBASE* records from within *1-2-3*, and proffers a variety of tools for manipulating those records. Using *Deja*, you can open a *dBASE* database, examine the records therein, locate specified records, change records, create new records, transfer selected records into a Lotus worksheet or transfer the contents of a worksheet into a database file, and finally update the original *dBASE* data file. Or you can create a new database from within *1-2-3*, which will be stored in the form of a *dBASE* file. So whether you want to work with departmental data or simply move your individual *1-2-3* databases into external files, *Deja* offers a solution—as long as the industry-standard *dBASE* file format fits your needs.



With Deja, *you can open a* dBASE *database, examine its records, create new ones, transfer them into a* 1-2-3 *worksheet, or, as shown here, import worksheet contents into a* dBASE *file.*

When you issue the command to open an existing database file with *Deja*, the file is not loaded into *1-2-3*. Instead, *Deja* presents a window into the file through a *1-2-3*-worksheet-like screen, in which the column designators across the top of the screen are replaced by the field names from the database, and the row numbers along the left-hand side of the screen are replaced by record numbers. One or two screenfuls' worth of data are loaded into the memory at a time, but essentially you are working with the disk-based database, and all additions, changes, or deletions you make in it are immediately saved to the disk file.

You can navigate through the database using standard Lotus cursor control keys: End-Down takes you to the last record, Home to the first record, and so on. In addition, you can scroll up or down throughout the database by using the key combinations End-PgUp or End-PgDn, respectively.

You have a good deal of control over how *Deja* displays the database. You can hide columns or change their width. You can also use *Deja*'s Database Filter to view only a subset of records. In an invoices database, for instance, the filter AMOUNT_DUE > 1000 would result in *Deja*'s displaying only those records for which the amount due was more than $1,000. Moreover, until the filter was removed, only those records would be affected by subsequent commands.

QUERIES You can also use *Deja* to make database queries, simply by entering its Locate command and then the criteria by which you wish to search the database. In the example data file described above, the query request AMOUNT_DUE >

PC MAGAZINE FACT FILE

Deja
PC Publishing Inc.
1801 Ave. of the Stars, #507
Los Angeles, CA 90067
(800) 634-4555
List Price: $129.95
Requires: 60K RAM; *Lotus 1-2-3*, Release 2.0 or later.
In Short: *Deja* works the twin miracles of making existing database files available to the *1-2-3* user and of allowing existing worksheet-based databases to be moved to a readily accessible disk-based format. Not copy protected.
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CIRCLE 182 ON READER SERVICE CARD

5000 would move the cursor to the next record in which the amount due exceeded $5,000.

Deja's query and filter commands can be set to look either for exact matches to the search request or for matches plus supersets of the requested data. For instance, if *Deja* is set for exact matches, a search for the string "Smith" would return only those records containing that name. If the exact option is turned off, records containing entries like "Smithy" and "Smithtown" would also be returned.

■ *Deja* gives *1-2-3* users the ability to access dBASE records from within *1-2-3*.

The *Deja* query and filter functions support a wide variety of operators: mathematical (+, -, /, *,), label (concatenation and concatenation without spaces), relational (=, <, >, <=, =>,<>, $), and logical (.AND., .OR., .NOT.). They also support a number of mathematical, algebraic, date/time, and string-manipulation functions. These functions and operators can be used together to make complex queries and requests to the database. *Deja* allows you to enter, edit, and delete database records (or to protect certain records so that they cannot be altered). New records are added to the end of the database file as you enter them. At your option, records marked for deletion may be displayed until they are actually purged from the database or only until they are hidden.

Database records can be copied into a *1-2-3* worksheet by identifying the records to be transferred and the destination cell range. Record numbers and field names can be transferred along with the records, at the user's option. Alternatively, worksheet records can be copied into a database file. No matter which direction you take, the transfer is almost instantaneous.

All of *Deja*'s functions can be automated using *1-2-3* macros, allowing the experienced *1-2-3* user to build complex database management systems relatively quickly. *Deja* adds 19 new @ functions to *1-2-3*, greatly simplifying the task of building macro applications that use *Deja*. These functions can be used anywhere within *1-2-3* to obtain general information about the open database, to extract data from it, or to update it. But most of these functions can result in extremely long recalculation times when they are applied to every record in a large database. Consequently, the *Deja* manual suggests that they should generally be used only within a macro-driven application, and that they should be applied only to a small subset of the database.

Overall, *Deja*'s capabilities are impressive. One does feel somewhat handcuffed at times when working with an open database file; it would be nice to be able to apply *1-2-3*'s sorting or graphing capabilities, for instance, directly to the data. Then again, the feeling is provoked precisely because *1-2-3* spoils the user by keeping all data in memory and thus instantly accessible and manipulable. If *Deja* requires you to copy the data you wish to work with into the *1-2-3* worksheet before carrying out those functions, the extra step seems a reasonable price to pay for *Deja*'s RAM-limit-busting ability to work with databases of almost unlimited size, for the ability to work with *dBASE* files, and for the opportunity to move your crowded *1-2-3* databases out of RAM and into a readily accessible disk file.—**B. G. Waldman**

Fetch.*

Database add-ins for *1-2-3* and *Symphony* tend to fall into two broad groups: those that provide new ways to manipulate data within *1-2-3*, and those that provide new ways to get the data there in the first place.

*Fetch.**, as its name implies, belongs to the second genre. It adds little in the way of new capabilities to the array of database functions found in *1-2-3* and *Symphony*. However, by virtue of its ability to import (and export) just about any structured data file, it opens up a universe of new data to which the user may apply those functions.

Moreover, because its import function is selective, importing only those records that you specify (through the use of a Lotus criterion range), *Fetch.** enables you to get around Lotus's memory limitations and work effectively with very large database files.

Imagine, if you will, a single program that automatically allows you to read, write, update, sort, and make queries to files created by all versions of *Lotus 1-2-3* and *Symphony*, *dBASE II* and *III*, *R:base*, *Reflex*, *WordPerfect* (merge files), *PC-File*, *VP-Planner*, and other programs, as well as .DIF and .CSV (comma-separated variable) files—a program that also makes it easy to set up custom import/export tables for other data formats—and you have an idea of the power of the *1-2-3* and *Fetch.** combination.

In the incarnation in which we saw it, that power was somewhat raw. This review was conducted with a prerelease version of Fetch.* and a preliminary, incomplete, set of documentation, so it was not possible to test all of *Fetch.**'s attributes. Pressing the help (F1) key, for instance, produced only the message "This is a test of the help function." Finished products were to be released November 16.

IMPORT/EXPORT ABILITIES Nevertheless, we were able to test *Fetch.**'s ability to import data from and export it to a number of data file formats, including *dBASE*, *R:base*, and *Reflex*, and were impressed with the ease of the operations.

*Fetch.**'s import/export functions revolve around a file description table which

PC MAGAZINE FACT FILE

Fetch.*
Manusoft Corp.
8570 W. Washington Blvd.
Culver City, CA 90232
(800) 292-6123
(213) 559-1561
List Price: $99.95

Requires: 60K RAM; *Lotus 1-2-3*, Release 2.0 or later, or Symphony (any version).
In Short: *Fetch.** provides *1-2-3* and *Symphony* with a mechanism for accessing or creating data files in a wide range of standard formats, including those used by *dBASE*, *R:Base*, *Reflex*, and other programs, and to manipulate the data in those files from within *1-2-3*. Not copy protected.

CIRCLE 657 ON READER SERVICE CARD

Fetch.* *can read, write and update, sort, and query files created by a variety of spreadsheet, database, and word processing programs, including* dBASE, R:base, *and* Reflex.

contains the information that *Fetch.** needs to know about the data file being used, including the record length, record and field separators, date format used, number of records, and the like. One of the most impressive things about *Fetch.** is its ability to generate that information by itself, with little or no user intervention.

For instance, when creating a new data table you can tell *Fetch.** that the data for the table is to be imported from a file currently stored in a *Reflex* .RXD file. *Fetch.** responds by presenting a list of the .RXD files on disk from which you choose the one you wish to use. Once you've done so, it reads the first record of the file and automatically creates the file description table, and several other tables equivalent to Lotus data output and criterion ranges. You are then free to start importing records simply by selecting Import from the *Fetch.** menu. If you prefer, you can first use the criterion table to specify the records you wish to import. Once you've specified the records you need, you can opt to import them all at once, or to examine each one before placing it in the worksheet.

The same automatic process is used to generate file description tables for importing data from *R:Base*, *dBASE*, *Lotus 1-2-3*, .CSV, and .DIF files, and for exporting *1-2-3* data to these data formats.

Importing data from or exporting it to a format that is not automatically recognized by *Fetch.** is more involved, since you'll have to build the file description table yourself. This involves supplying *Fetch.** with information about the physical structure of the file (record and field lengths, separator characters, and the like), and the formats used to store numbers, text, and dates within the file, a process that will no doubt involve much trial-and-error experimentation. Nevertheless, it only has to be done once for each program you use and can be avoided altogether if your program can generate a .DIF, .CSV, *dBASE* or other *Fetch.**-supported file format.

In addition to its import and export capabilities, *Fetch.** provides a number of new @ functions that can be used to perform database functions on external files without importing the file into Lotus. These include special *Fetch.** equivalents of the Lotus @AVG, @COUNT, @MAX, @MIN, @STD, @SUM, and @VAR functions, as well two new functions @FFIND and @FRECORD, which return the current record number and contents, respectively.

*Fetch.** occupies 60K of RAM, a small price to pay for all the impressive new capabilities it offers for manipulating non-*1-2-3* data within a *1-2-3* environment. It can be a valuable addition to anyone's collection of Lotus utilities, and a valuable component of a macro-language-based Lotus application. The possibilities offered by linking it through a macro program to one of the entry-forms-creation programs reviewed here, such as *D.A.V.E.* or *Data Manager*, are particularly intriguing.—**B.G. Waldman**

Informix Datasheet Add-In

Informix Datasheet Add-In, from Informix Software, is unique among the database add-ins reviewed here in terms of both its scope and its complexity. While most of the other database add-ins for *1-2-3* are primarily designed to serve as flat file data managers, *Datasheet* is an ambitious attempt to provide *1-2-3* with relational, disk-based, SQL (structured query language) database functions. In the process, it creates a link between *1-2-3* and Informix's family of UNIX, VMS, MVS, and MS-DOS database products.

Perhaps *Datasheet*'s most impressive achievement, considering the radical en-

PC MAGAZINE FACT FILE

Informix Datasheet Add-In
Informix Software Inc.
4100 Bohannon Dr.
Menlo Park, CA 94025
(415) 322-4100
List Price: $199.99
Requires: 640K RAM; *Lotus 1-2-3*, Release 2.01.
In Short: *Informix Datasheet Add-In* is a powerful SQL-based relational database management tool that allows the *1-2-3* user to create and work with disk-based database files stored in a format compatible with that used by other members of the Informix family of database management products. Not copy protected.

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The design of the Micro Channel also provides a faster, more efficient way to connect your

an IBM PS/2, the bus.

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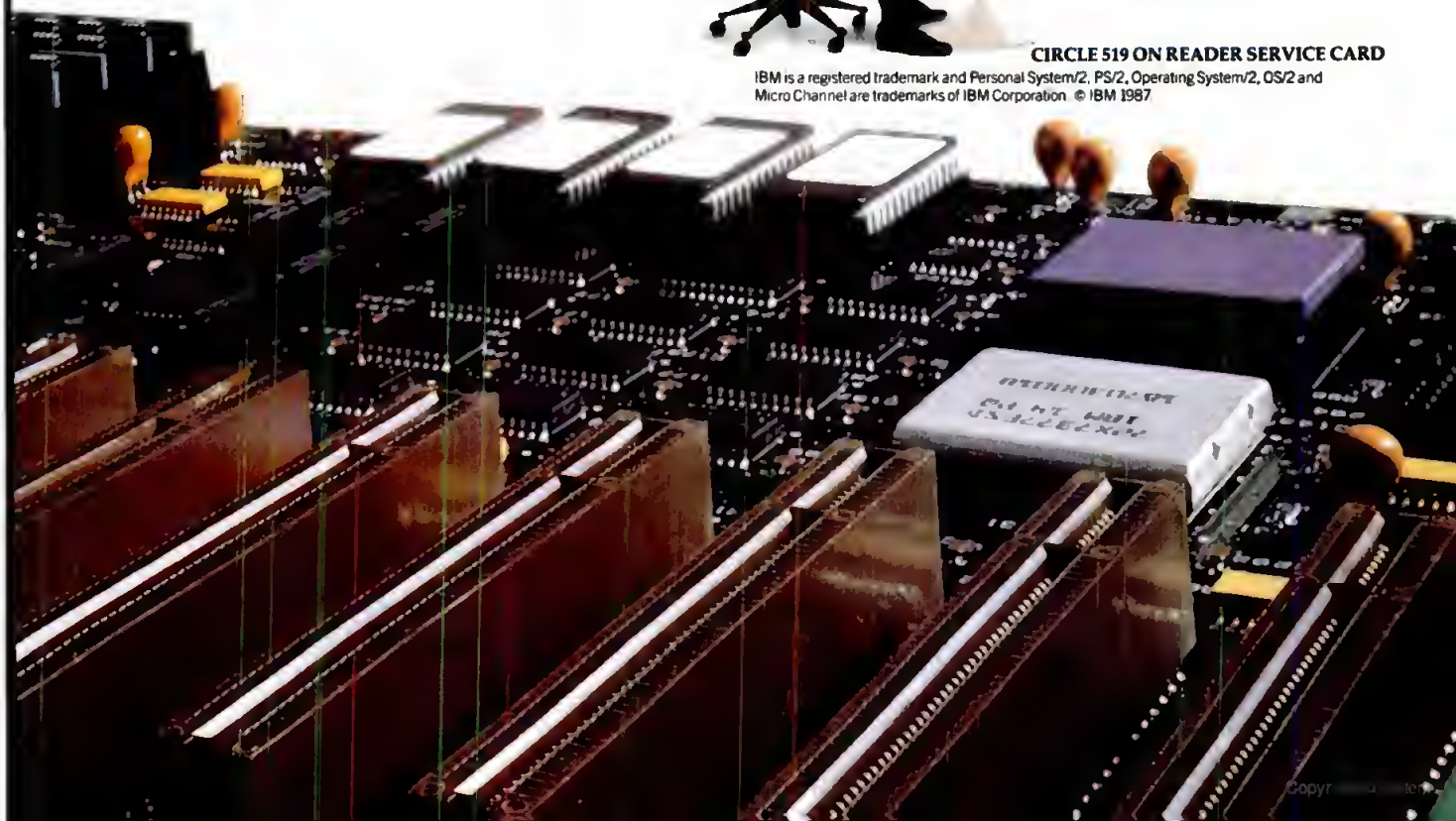

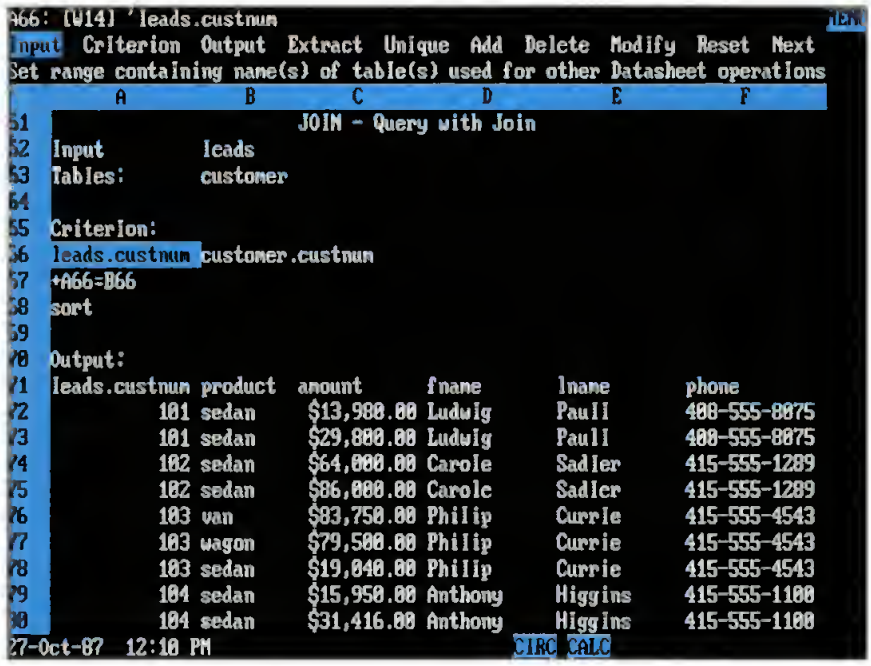

Datasheet Add-in *lets you use Lotus-like input, output, and criterion fields to create, modify, and manipulate relational databases. It's also a link to Informix's SQL database products.*

hancements it makes to *1-2-3* data functions, is the degree to which it blends into the *1-2-3* environment. While it is accompanied by two lengthy and well-written full-size manuals—one tutorial, one reference—experienced users of *1-2-3*'s data management functions will be able to get a good running start on *Datasheet* from the slim, 31-page pamphlet entitled "A Head Start for /DQ Users" that accompanies the package. That the Head Start manual is able to introduce *1-2-3* users to almost all of Datasheet's commands in so few pages is an indication of how well *Datasheet* mimics *1-2-3*'s data query command structure while performing such un-*1-2-3*-like tasks as adding, deleting or indexing rows stored in one or more disk-based relational databases.

Despite the ease with which experienced *1-2-3* users will understand *Datasheet*'s organization, this is not a product to be approached casually by those shopping for a little extra data management juice. The stereotypical *1-2-3* power user—he or she of the 250K worksheets—would be well advised to look elsewhere for a supplemental data management add-in, because *Datasheet*'s memory useage all but requires you to dedicate *1-2-3* to the task of database management.

NOT YOUR TYPICAL ADD-IN *Datasheet* is too rich and complex a program to fit into the compact 64K slot occupied by the typical add-in. Instead, the majority of the *Datasheet* program—about 200K of code—is loaded from disk before one loads *1-2-3*, by running STARTSQL .EXE. *1-2-3* is then loaded into memory using a special loader program, IDA.EXE, to avoid overwriting the STARTSQL code. Then the *Datasheet* add-in itself must be attached to *1-2-3*, eating up a little more RAM and resulting in a total workspace of approximately 78K in a 640K machine. Even if you detach the *Datasheet* add-in, you gain only about 15K more usable RAM—so unless your machine is loaded with extended memory, *Datasheet* isn't the kind of add-in you can load into the background and forget about until you need it.

■ *Datasheet Add-in* links the PC and *1-2-3* user to the powerful Informix-SQL database system.

For anyone willing to make a commitment to *Datasheet*—and I can think of several scenarios in which it would make sense to do so, such as when you have access across a LAN or a minicomputer link to departmental databases created using Informix-SQL—the rewards that come from doing so are abundant. To put it as simply as possible, *Datasheet* translates *1-2-3*-like data query commands into SQL requests, which it then applies against an external database.

Thus, by using Lotus-like input, output, and criterion fields, you can create, modify, index, and manipulate relational databases. Each database consists of a number of tables—akin to flat database files—consisting of fields and data for each field arranged in a column-and-row format. You can index fields and can create query requests linking multiple tables using any number of search criteria. You can also create new database files or use tables in existing Informix databases.

The result is an extremely powerful relational database management tool, but not an especially user-friendly one. *Datasheet* does not include an automatic data-entry form generator, as one might find in *Data Manager* or *D.A.V.E.* Moreover, any tool that mimics the command structure of Lotus's data query command isn't friendly. However, much of *Datasheet*'s unfriendliness could be overcome with a well-written macro-based application.

Questions of friendliness aside, *Datasheet* is a remarkably powerful tool for a couple of reasons. One is that it links the PC and *1-2-3* user to the powerful Informix-SQL database system. The other is that it allows the user to bring the analytic and data manipulation tools of *1-2-3* to bear against a database. *Datasheet* is overkill for most *1-2-3* data management requirements, but for those situations in which its capabilities are needed it is an admirably powerful and complete professional tool.—**B. G. Waldman**

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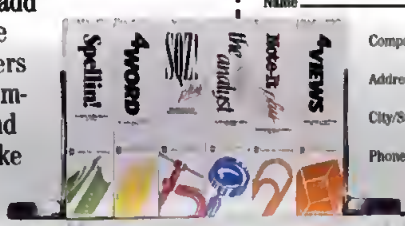

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CIRCLE 368 ON READER SERVICE CARD

Printing, Graphics, and UTILITIES

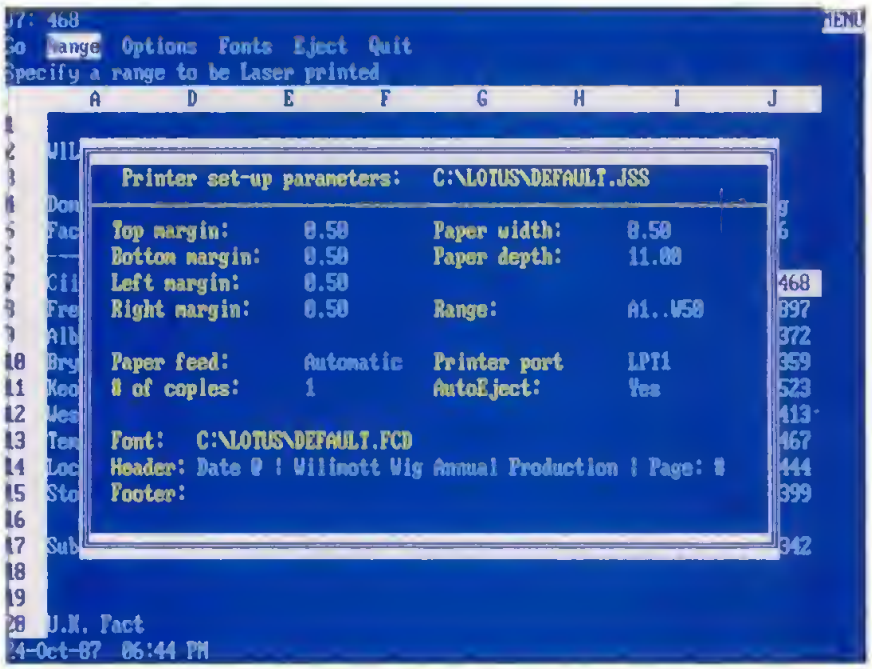
Sometimes it's the little things that count. You might have conquered the thorniest forecasting problem imaginable, and, with the help of tortuous and brilliant macros, created a business plan that will make you famous. Then you try to print out the spreadsheet to submit along with your report, only to find you'll have to spend 2 days with three rolls of Scotch tape and a table as long as the bar at the Plaza Hotel. And even after you've meticulously patched together all those sheets of paper, your spreadsheet won't exactly complement the report you cranked out with *PageMaker* and a color printer. Hmmm. Time for *Sideways*, an indispensable program, and perhaps the best-known of the products we classify here as add-in utilities. Take a look at *SeeMORE*, too; it lets you see a lot more of your spreadsheet on the screen, sort of like a video version of *Sideways*.

1-2-3 is great at lots of things, but presentation graphics isn't one of them. And when it comes to three-dimensional graphics, forget it. Of course, you can use *Perspective* or one of the other standalone graphics packages to bring depth to your *1-2-3* graphs. But if you're bent on an all-in-one solution, see our review in this issue of Intex Solutions' *3D Graphics*, a *1-2-3* add-in that does just what its name says.

JetSet

JetSet is an idea whose time doesn't seem to have come yet.

Nothing's wrong with the idea itself. *1-2-3* could use an add-in LaserJet utility that would save you from typing in complex command strings every time you wanted to change a font. Besides, most *1-2-3* users have fantasized for years about an easy way to control margins, add headers, footers, and page numbers, create default formats for individual spreadsheets, and use proportional fonts without producing mass chaos.



JetSet's setup screen is where you specify margins, fonts, headers, footers, and other printing parameters for laser output of worksheets. You can save the formats to use with other files.

JetSet, a $79.95 add-in from Intex Solutions, promises to perform all these wonders and more. Nothing's wrong with it except the way it fulfills its promises.

JetSet looks terrific on screen. The Add-In Manager integrates it into *1-2-3*, and you use it in place of Lotus's print function (which remains available). You can call up different control files for Hewlett-Packard font cartridges and soft fonts, and you can point to a default font for your spreadsheet. You can specify paper size and margins while consulting a layout diagram that the program pops up for easy reference. A header-and-footer option lets you enter variables that print out as the page number and current date, and you can justify sections of the header at the left and right margins while centering a third section. You can save the format selections to use as a default for other spreadsheets.

One or two details may annoy you as you're setting up a format. If you want some rows or cells in your spreadsheet to print out in a font different from the default, you can't simply define a range and tell the program to print it in a different style. You have to enter font identification codes directly into the spreadsheet at the point where you want the font to change, and then you must enter the specific code for the default font wherever you want to change back to the font you thought you already selected from a menu. You have to enter similar codes to start and stop underlining or boldface.

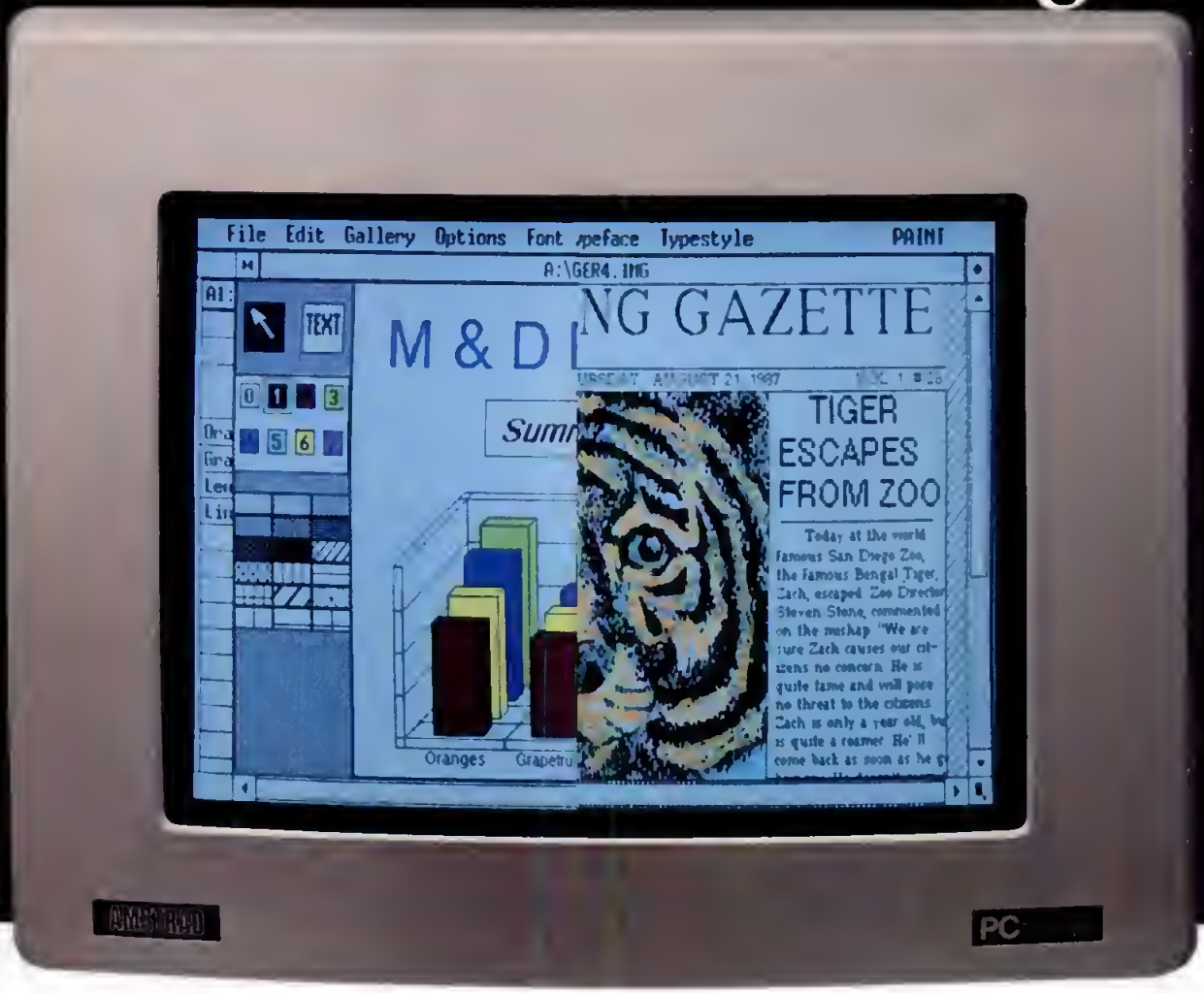
But these seem minor problems of setup because the manual promises to give

PC MAGAZINE FACT FILE

***JetSet*, Version 1.0t**
Intex Solutions Inc.
568 Washington St.
Wellesley, MA 01281
(617) 239-1168
List Price: $79.95
Requires: 50K RAM, *Lotus 1-2-3*, Release 2.0 or later, Hewlett-Packard LaserJet or compatible.
In Short: A *1-2-3* add-in that gives erratic control over laser printing. Not copy protected.

CIRCLE 665 ON READER SERVICE CARD

A computer for the left brain. And the right.



Until now, choosing a computer typically meant choosing between capabilities. If you needed a computer primarily for serious business needs, then a computer with IBM compatibility was the only rational (left brain) choice, right?

But if you were looking for desktop publishing capabilities to display your creativity (right brain), then a computer designed for mouse-driven, windowing, graphics software was the way to go. Right?

*Source: International Data Corp.

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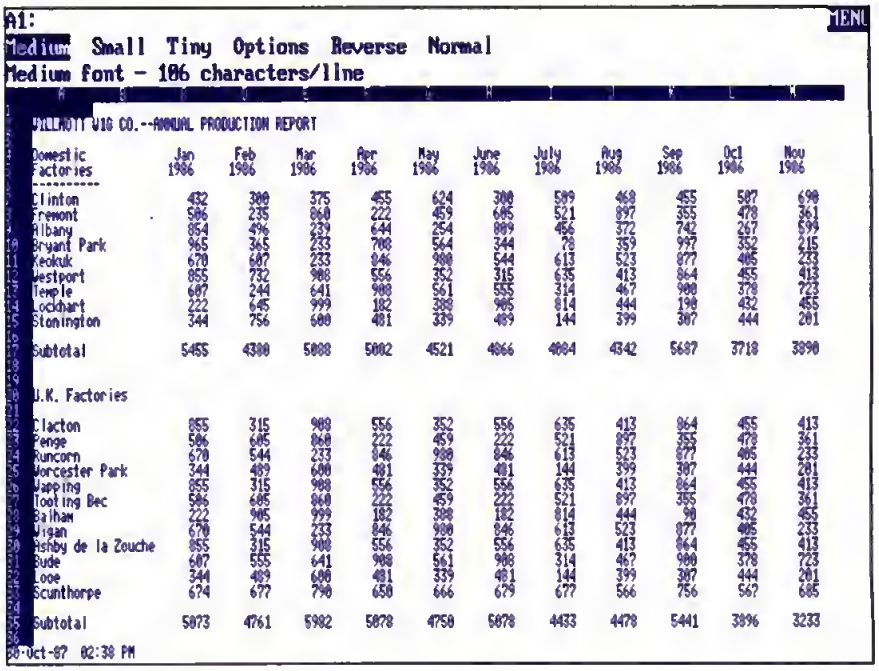
CIRCLE 303 ON READER SERVICE CARD

superb printouts when you're through. When you're ready to print, all you need to do is define a range, press Go from *JetSet*'s print menu, and sit back to savor the results you've been fantasizing about. This is the moment when you return to hard reality.

The manual asserts in boldface type that *JetSet* correctly handles proportional fonts when printing spreadsheets. The printed spreadsheets say something very different. Your headers and footers probably don't have the same margins as the spreadsheet. If you followed the examples in the manual and put the date at the left of the header, a title in the center, and the page number at the right, the title isn't at the center but at a position two-thirds to the right. If you used control codes in the header, some of the header disappeared. If you marked a row to be printed in a font larger than the default, the row begins to the left of the left margin. If you used continuous lines of characters to divide different sections of the spreadsheet, the lines print out with unsightly overlaps or breaks. Some characters in column headings may be printed on top of each other.

If this makes you decide to be less ambitious and use a single default monospace font without fancy features, *JetSet* will print your spreadsheet more or less correctly. Just don't try to save the default font for later use when you save the default parameters. The program ignores your font selection when it saves your settings, and you have to reselect the same font the next time you use *1-2-3*. And if you enter printer codes for any rows of your spreadsheet, you have to reenter them on every page.

Jim Seymour recently reported a conversation with a British programmer who complained that Americans want "excessive functionality" from their programs. The readme file on the *JetSet* disk describes the "improved functionality" of the latest version. Not to worry. It may be improved, but no one will accuse it of being excessive.—**Edward Mendelson**



By offering three sizes of condensed type, SeeMORE *gives you more spreadsheet on your screen. The top three lines are always displayed in Normal mode, making it easier to choose commands.*

od of groping around, a few cells at a time, trying to remember what you did. *SeeMORE*, from Personics Corp., can compress your work so that two, three, or four times the usual number of cells can be displayed on the screen.

If you follow the simple instructions for loading the program, you'll copy 12 files onto your hard disk. Later you can save about 130K by deleting the ones you don't need. Or, if you are one of the rare breed who reads the manual for new software before turning on the computer, you'll have no trouble figuring which of the files, thoughtfully listed in the manual, you really need.

But you'll soon join the majority who skims documentation, then hacks their way around programs until forced to refer to the manual. This manual is commendably brief and could have been briefer, since it mostly describes features you can explore easily from the self-explanatory choices on its Lotus-like menus. What the manual doesn't tell you is how to get to the first menu. Actually, all you have to do is repeat the method you used to invoke *SeeMORE*, i.e., hit the Alt-function key combination again or choose "invoke" again from the Alt-F10 menu.

That first menu offers three choices of font size: Medium, Small, and Tiny. The manual suggests that the Tiny characters are "so ridiculously small" that you will only use them for quick bird's-eye views of worksheets. But don't give up on that

SeeMORE

Sometimes titles take up so much space in a *1-2-3* spreadsheet that there's precious little worksheet left on your screen for the numbers. Revisiting such worksheets after several months can mean a frustrating peri-

PC MAGAZINE FACT FILE

SeeMORE
Personics Corp.
2352 Main St., Bldg. 2
Concord, MA 01742
(617) 897-1575
List Price: $79.95
Requires: 70K RAM; *Lotus 1-2-3*, Release 2.0 or later; CGA, EGA, VGA, Hercules, or compatible graphics adapter.
In Short: An easy-to-use screen manager that compresses characters and allows you to see two, three, or four times the normal area of worksheet. A bonus is the standalone GRAFPLUS program, which lets you use the PrtScr key for hard copies of graphics screens. Not copy protected.

CIRCLE **663** ON READER SERVICE CARD

size until you've tried it with combinations of the many Options available on subsequent menus. It was fine on the hybrid monochrome setup I normally use for Lotus—after I used the Reverse option for black characters forced to uppercase on one of the light background "colors" available. Whichever combination of size and other options you find most pleasing during your exploration should be saved as your default setting. You won't want to fiddle with all the settings every time you use *SeeMORE*, particularly since it spits you back to your worksheet after you make each choice from the menu.

A clever feature of *SeeMORE* is its ability to display the top three lines, the menu area in *1-2-3*, in normal-size font, regardless of the degree of compression you have selected for the worksheet itself.

■ You'll appreciate the larger characters and proper shape of transparencies made from *Sideways* printouts.

A not-so-clever feature is its ability to save a file in Tiny mode that cannot be retrieved by normal *1-2-3*. Don't worry, a combination of CPR and Ctrl-Alt-Del will restart your heart and your PC; then you can retrieve the file with *SeeMORE* set to Tiny. You will avoid wear and tear on your loved ones by saving files only in the normal mode.

When you invoke *SeeMORE* with one of its compressed fonts, you can no longer use the PrtSc key to get a hard copy of the screen. Personics more than compensates for this minor drawback by providing on the *SeeMORE* program diskette four GRAFPLUS files, one of which will work with your printer to allow you to use the PrtSc key to capture not only the compressed worksheet screens but any graphics screen—including *1-2-3* charts and graphs. And it will print sideways, so your printout is the same shape as your screen.

SeeMORE is habit-forming. I thought, at first, that it would fall into the "gimmick" category, something to make my *1-2-3* look different. I would attach it only when I intended to invoke it. Now I use it often enough to consider having it autoload, and I have not entirely ruled out the possibility of auto-invoking, even though I'd then have to play referee between *SeeMORE* and its add-in brethren.

—Geoff Daw

Sideways

There are one or two pieces of software I carry in my briefcase at all times for fear that I might find myself in an office with ill-equipped PCs. *Sideways*, from Funk software, is an important element in that software survival pack.

The version I carry is old. The documentation was lost long ago. But the program does exactly what I need: it gets me hard copies of wide spreadsheets by turning them sideways in the printer. Several attempts to buy later versions were thwarted by my local software store, which was always about to have its sold-out status corrected "next Thursday." So it is that I have leaped from that first standalone version, which worked only with .PRN *1-2-3* files, directly to the latest incarnation in add-in form.

This was the first add-in I installed, so I used the batch files provided for that purpose and clearly described in the manual. Installing subsequent add-ins, I followed Jim Seymour's advice (see "Memory Matters" sidebar) and checked the dates of the Add-In Manager files to be sure not to install older versions. You'll probably want to install on a hard disk all three varieties of *Sideways* provided: *1-2-3* add-in, *1-2-3* standalone, and text standalone; each has its uses.

When I first invoked *Sideways* as an add-in, my expectations were high; I figured that a lot must have happened since my original version. I was wrong. But as I began to work with it, I didn't mind: it still does exactly what I want and, since it does it the same way, I don't have to learn it all over again. That's not to say that a newcomer will need to invest an unreasonable amount of time in learning how to use *Sideways*—it's easier than the regular Print function in *1-2-3* for most people.

Typically, the first step in printing a spreadsheet with *Sideways* is to specify the print range. *Sideways* defaults to a print range embracing the entire worksheet—that's not been right yet for me, but it's as good a place as any to start. You adjust it just as you do in *1-2-3*. Then, from the Lotus-like menus, comes the choice of character size. There are nine to choose from, ranging from "mammoth" to "minuscule." Depending on your printer, the character size you use will allow from about 38 to as many as 87 rows to be printed from your worksheet. The number of columns it will print is unlimited, of course. Knowing the smallest-size print I can live with, I try hard to keep my worksheets shorter than 70 rows.

From this point you are into cosmetic improvements for your printout—double-density printing, margins, skipping over perforations, repeating border areas on each sheet, and special effects. Special effects consist of bold, underlined, and expanded type applied to selected ranges.

Since most worksheets are wider than they are long, you may think that the only role for *Sideways* is to get those worksheets onto paper using one of the smaller print sizes. But its large print has its uses, too. Print out a "mammoth" worksheet, tape it together, and take it to a meeting—it's easier for a group to pore over than a single monitor. If you've ever squinted at worksheet extracts on an overhead projector, you'll appreciate the larger characters and proper shape of transparen-

PC MAGAZINE FACT FILE

Sideways
Funk Software
222 Third St.
Cambridge, MA 02142
(800) 822-3865
(617) 497-6339
List Price: $69.95
Requires: 75K RAM; *Lotus 1-2-3*, Release 2.0 or later.
In Short: An indispensable utility, now in add-in form, that turns worksheets sideways, allowing them to print continuously on fan-fold paper. Not copy protected.

CIRCLE 664 ON READER SERVICE CARD

■ *3D Graphics* gives you control over the rotation of the graph and over the viewpoint.

cies made from *Sideways* printouts.

As an add-in *Sideways* needs 75K of memory, so care must be taken if you use large worksheets or other add-ins. Printing is rather slow: even with a print buffer you'll lose the computer for several minutes with larger worksheets.

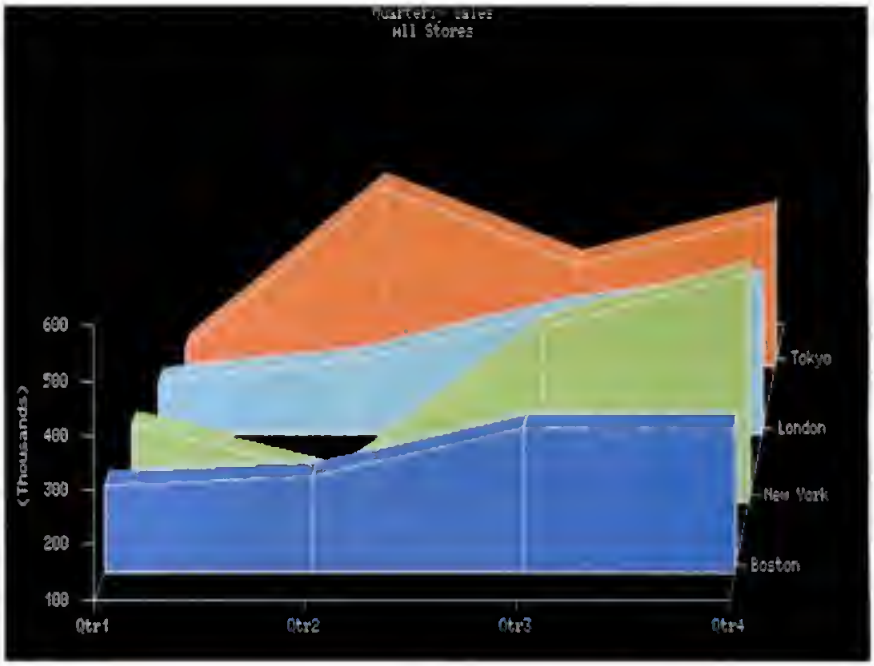
One improvement I had hoped for, perhaps unreasonably, was some degree of WYSIWYG. Although *Sideways* will not split a column when it skips the perforation, it can't tell that you have groups of columns that shouldn't be separated. If you could preview the breaks on your screen, you could pad columns or insert empty ones to keep related columns together on the page.

Unless all your worksheets are tall and skinny, you need *Sideways*. If you already have a standalone version, it's worth upgrading to Version 3 for the convenience of working from within *1-2-3* and the added options.—**Geoff Daw**

3D Graphics

The first time anyone outside of Lotus heard of an add-in was at the *Symphony* introduction. Then-Lotus chairman Mitch Kapor wowed the assembled press and analysts by showing off a rough three-dimensional graphics add-in that literally added a new dimension to the traditional array of Lotus graphics functions. The demo was all the more impressive for his noting that it had been written in a few hours by a part-time Lotus employee who doubled as a full-time high school student.

Now, some years later, we have a finished, commercial three-dimensional graphics add-in for both *Symphony* and Releases 2.0 and later of *1-2-3*: the straightforwardly titled *3D Graphics*, from Intex Solutions.



3D Graphics *offers surface graphs, bar graphs, financial graphs, and other three-dimensional representations of* 1-2-3 *data. Graphs can be rotated and viewpoints changed.*

In action, *3D Graphics* is every bit as straightforward as its name. It offers the CGA, EGA, or Hercules monochrome graphics user an alternative to *1-2-3*'s or *Symphony*'s rather drab two-dimensional graphics functions in the form of five basic varieties of three-dimensional graphs, and it presents that alternative in a way that should be instantly usable by anyone familiar with *1-2-3*'s or *Symphony*'s graphics commands.

3D Graphics' menu of graph types consists of surface graphs, which can be used to display up to a 100 by 100 array of continuous data; three-dimensional bar graphs, using either filled or unfilled bars; joined bar graphs, in which the tops of the bars are joined to form a continuous slope; line graphs, a variant of the joined bar graph in which only the top surface of the bar is displayed; and financial graphs, three-dimensional bar graphs capable of displaying both positive and negative values.

The data to be used to create any of these graph types is defined much as it would be with *1-2-3* or *Symphony* standard graphics functions, although the process is actually easier with *3D Graphics*. To produce a simple three-dimensional graphic, you need only identify the type of graph to be produced and, using Lotus's point-and-shoot highlighting to identify any continuous two-dimensional array of data on the worksheet, the data range to be graphed (the "A" range). Once you identify the data range and issue the *3D Graphics*

PC MAGAZINE FACT FILE

3D Graphics
Intex Solutions Inc.
568 Washington St.
Wellesley, MA 02181
(617) 239-1168
List Price: $79.95
Requires: 50K RAM; *Lotus 1-2-3*, Release 2.0 or later, or *Symphony*; CGA, EGA, or Hercules monochrome graphics adapter.
In Short: *3D Graphics* offers *1-2-3* and *Symphony* users five types of three-dimensional graphics in a form that should be immediately understandable to anyone familar with Lotus two-dimensional graphics. Not copy protected.

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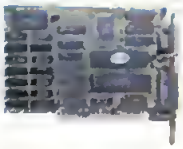

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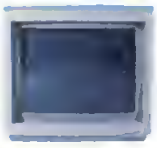

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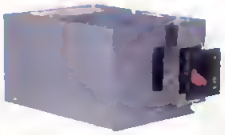

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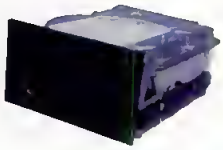

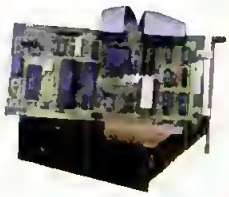

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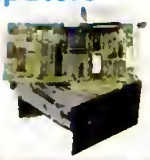

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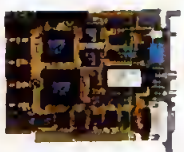

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View command, a basic three-dimensional graph will be displayed. The graph won't tell you anything about the data being graphed, but that situation can be quickly rectified by labeling *x*- and *y*-axis labels (to run across the bottom and from front to back, respectively), up to two lines of titles to go at the top of the graph, and additional titles for the *x*, *y*, and *z* axes. The commands for these functions are identical to those in *1-2-3*'s standard two-dimensional graphics menus.

3D Graphics, like *1-2-3* and *Symphony*, also offers the user a variety of controls over the appearance of the graph. These include control over the *z* (up and down) scale, which enables the user to set upper and lower limits on the data points to be graphed, and hence to "clip" three-dimensional graphics to produce graphs of limited datasets. The user can also specify whether numeric indicators such as "thousands," "millions," or "times 10E9" appear alongside the *z* scale, and in what format (fixed, scientific, currency, comma, general, plus/minus, or percent) *z*-scale numbers are displayed.

DISPLAY OPTIONS There are also a number of display options specific to the appearance of three-dimensional graphics. These include a Contours command, which controls the number of colors used to indicate changes in level on a three-dimensional surface plot, and Width and Depth commands, which control those aspects of the bars in three-dimensional bar charts. By carefully adjusting the Contours command you can make it much easier to differentiate the levels in a surface plot, while the Width and Depth commands can be used to dramatically change the appearance of three-dimensional bars from tall thin boxes to long flat ones, to square cubes, or to all-but-dimensionless vertical lines.

3D Graphics also gives you control over the rotation of the graph (allowing any of the graph types to be rotated 0, 90, 180, or 270 degrees), and over the viewpoint. Changing the viewpoint from low to medium to high changes the viewer's angle of perspective on the graph. A low perspective presents the most dramatic contrasts in terms of the height of bars and so forth, while a high perspective can reveal data that otherwise might be lost behind tall bars in the front of the graph.

Like *1-2-3*'s standard two-dimensional graphics, graphs created with *3D Graphics* can be saved in a .PIC file for later printing by *PrintGraph* or *Freelance*, or can be named and saved in a .3DP file for retrieval and manipulation within the *3D Graphics* add-in. Printing a *3D Graphics* .PIC file from *PrintGraph* or *Freelance* is like printing a standard Lotus graphic.

All told, *3D Graphics* is a remarkably simple and straightforward addition to *Lotus 1-2-3* or *Symphony*, and deserves high marks for its ease of use—which derives largely from the degree to which it has maintained the conventions of Lotus two-dimensional graphics. It is not as ambitious in scope or options as, for instance, *Perspective*, with its almost endless array of two- and three-dimensional chart types and its ability to change perspective, rotation, and the like on a degree-by-degree basis. Nevertheless, *3D Graphics* is a worthy addition to *1-2-3* that, on the basis of its convenient add-in status and instantly recognizable command structure, probably fits the needs of most *1-2-3* users better than any standalone three-dimensional graphics program.—**B.G. Waldman**

Planning and Forecasting ADD-INS

Putting mounds of easy-to-manipulate data at your disposal, spreadsheets are logical tools for forecasting work. You can do a lot of what-if-ing with macros and other formulas, but if you want to get into impact analysis, goal seeking, and statistical forecasting, an add-in is your best bet.

Reviewed here are the forecasting products from Enfin Software, the company with the most complete line of such add-ins. Available separately or as a forecasting kit, these programs should handle your planning needs expertly. We also look at *Wisard*, formerly available as a *1-2-3* add-on and recently upgraded to add-in status.

Decision Support Series

Goal Solutions-Plus, *Simulated Solutions-Plus*, and *Optimal Solutions-Plus*, from Enfin Software Corp., are financial decision tools that use add-in technology to bring forecasting and decision support to *Lotus 1-2-3* and *Symphony*. The programs can be purchased separately or as a package, *Decision Support One*, which costs $695.

Installation is automated through batch files. The process attaches the Add-In Manager to the *1-2-3* driver set created when *1-2-3* was first installed. The price of the Add-In Manager, in terms of RAM memory usage, is about 20K, and each of the *Decision Support Series* modules has a modest additional memory cost, ranging from about 11K to 33K.

The modules can all reside in memory simultaneously, one at a time or in combination. If memory is required for worksheet space, the *Decision Support* menu has an Unload command that clears all *Decision Support* modules from memory.

The menu displayed when the Add-In key combination is struck is the *Decision Support* menu, which assumes all modules available are installed. If a module is not installed but its command is keyed, the program asks for the path in which to find it. If the module isn't available, the Esc key brings you back to the menu.

Goal Solutions-Plus is a decision-sup-

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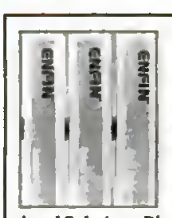

Decision Support Series
Enfin Software Corp.
6920 Miramar Rd., #106-A
San Diego, CA 92121
(619) 549-6606
List Price: *Goal Solutions-Plus*, $195; *Simulated Solutions-Plus*, $295; *Optimal Solutions-Plus*, $295; *Decision Support One* (all of the above), $695.
Requires: 320K RAM; *Lotus 1-2-3*, Release 2.*x*, or *Symphony*; DOS 2.0 or later.
In Short: True decision-support software, running within *1-2-3* or *Symphony*. Not copy protected.

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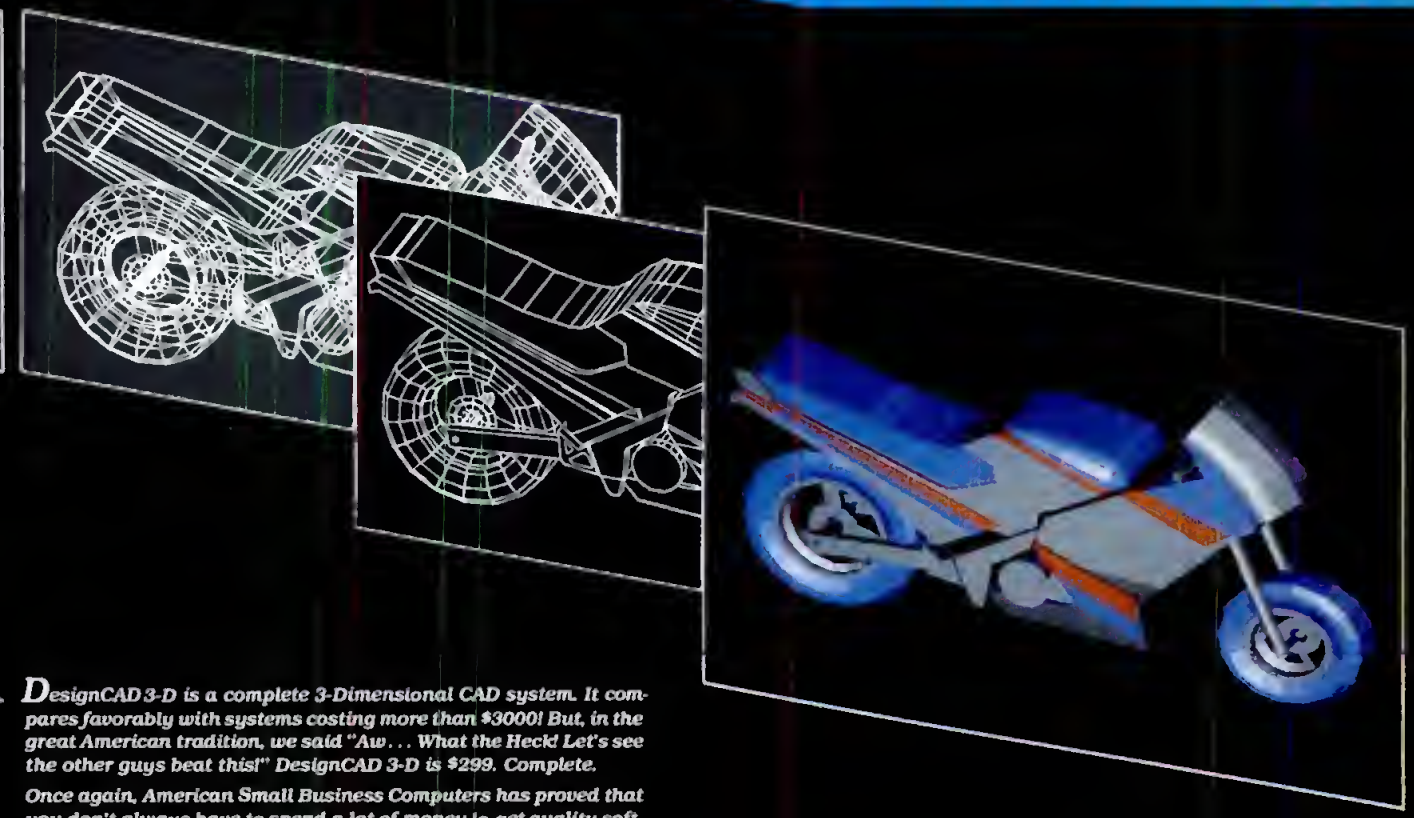

DesignCAD 3-D is a complete 3-Dimensional CAD system. It compares favorably with systems costing more than $3000! But, in the great American tradition, we said "Aw . . . What the Heck! Let's see the other guys beat this!" DesignCAD 3-D is $299. Complete.

Once again, American Small Business Computers has proved that you don't always have to spend a lot of money to get quality software. DesignCAD 3-D provides features such as Shading, Hidden Line Removal, Printer and Plotter support, and extensive file transfer capability, all for $299! No other 3-Dimensional CAD system can come close to providing the price/performance of DesignCAD 3-D.

There is a very important reason to buy DesignCAD 3-D other than price: PERFORMANCE. DesignCAD 3-D provides complete 3-Dimensional drawing capabilities. It's not a "warmed-over" 2-D program. DesignCAD 3-D allows you to draw any entity in 3-D space. This means, for example, that you can draw a curve in the shape of a spring. You can draw a circle or arc at ANY angle on ANY plane.

DesignCAD 3-D allows up to 4 simultaneous views - any angle or perspective - on the screen. DesignCAD 3-D also provides complex extrusions - linear, scalar, and circular. Extensive 3-D text capabilities and auto dimensioning are provided - at no extra charge, of course.

DesignCAD 3-D provides the capability to read drawings from most other CAD systems (DesignCAD/ProDesign II, AutoCAD's DXF, and IGES file formats). You can also send a view of a 3-D drawing to other CAD systems. These features are included at no extra charge, of course.

DesignCAD 3-D almost certainly is compatible with the computer system you now own. DesignCAD 3-D supports more than 200 dot matrix printers, at high resolution. DesignCAD 3-D supports more than 80 plotters, and most digitizers and graphics adapters available for "PC Compatible" systems. Shaded and wireframe models can be output to the printer or plotter YOU own.

DesignCAD 3-D does not require expensive graphics adapters and monitors - even shading can be done on ordinary displays such as the Enhanced Graphics Adapter (EGA), Color Graphics Adapter, or Hercules monochrome adapter.

However, the best reason to buy DesignCAD 3-D is not the low price. It's not the outstanding performance. It's not the extensive hardware compatibility. The best reason to buy DesignCAD 3-D is for its amazing ease of use!

DesignCAD 3-D provides powerful commands you can use to produce professional 3-Dimensional drawings in less time than you thought possible! DesignCAD 3-D commands can be selected from the menu or entered as fast, single keystroke commands. We have found DesignCAD 3-D to be easier to learn and easier to use than any 3-Dimensional CAD system for the IBM PC, at any price!

What else do you need to know about DesignCAD 3-D? Only this: "Included at No Extra Charge." What is included at no extra charge? EVERYTHING! $299 BUYS IT ALL!

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Planning and Forecasting Add-ins: Summary of Features

(Products listed in ascending price order)

		Decision Support Series		
	Wisard	Goal Solutions-Plus	Optimal Solutions-Plus	Simulated Solutions-Plus
	$99	$195	$295	$295
RAM requirement (above 1-2-3)	640K	320K	320K	320K
LIM EMS supported	○	○	Version 3.0 or 3.1	○
Regression analysis	○	○	○	○
Monte Carlo simulation	○	○	○	●
Graphing	○	○	○	○
Goal seeking	○	●	○	○
Impact analysis	○	●	●	●
Linear programming	○	○	●	○
Linear regression	●	○	○	○
Uses statistical techniques	●	○	○	●

●—Yes ○—No

port module that has a number of analytical functions. Highlighted here are goal-seeking and impact analysis.

Goal-seeking (much like that found in *microCUBE*, reviewed in "Challenging *1-2-3* on Price and Power," *PC Magazine*, October 27, 1987) is an extremely useful tool. In its simplest form, it gives you the ability to set the desired goal and solve for the variables within the formula that yield a particular result.

When *Goal Solutions-Plus* is invoked, a blank form appears in which information about the forecast model is placed. Some of the data required to solve for the specified goal includes the location of the objective and the variables, as well as the target amount. These locations are entered as cell addresses, or they can even be in the form of range names. All range names attached to the particular worksheet will "pop up" when you press the F3 key.

Variables may be determined within highs and lows, and you have the ability to solve for more than one goal or more than one variable, and to set priorities and precision. Once the results are calculated, they can be placed in the worksheet by pressing the F2 key. *Goal Solutions-Plus* wisely prevents the results from being placed over cells in a worksheet that contains formulas. This could destroy the integrity of the worksheet. Instead, *Goal Solutions-Plus* first issues a warning: if an alternate output range has been defined, the results will be written there.

■ Impact Solutions provides the capability for impact analysis or sensitivity analysis in *Lotus 1-2-3* or *Symphony*.

Included with the *Goal Solutions-Plus* module is a program called Impact Solutions. Impact Solutions provides the capability for impact analysis or sensitivity analysis in *Lotus 1-2-3* or *Symphony*. Its purpose here is to reduce the time it takes to analyze the impact of such variables as price or units shipped on profit and other objectives. Impact analysis is accomplished by using a form to define the objective, then entering the variables whose sensitivity to change, relative to the objective, you wish to test.

The screen presentation of these programs is pleasant and logical. Once *Goal Solutions-Plus* is activated, the function keys available are displayed at the bottom of the window. If you're familiar with *1-2-3* function-key operation, this program should be a snap because the actions invoked within *Goal Solutions-Plus* often use the same function key that *1-2-3* would use to perform a similar function.

The program also includes context sensitive on-screen help in a format similar to that of *Lotus 1-2-3*. It isn't as complete as the on-screen help text in *1-2-3* or *Symphony*, but serves as a reminder source for various functions. Having the ability to work backwards from a desired goal through a formula made up of variables and constants often allows more meaningful (and speedier) results in financial analysis. It also takes the guesswork out of what-if analysis.

Optimal Solutions-Plus, another Enfin module, is a decision tool for linear programming, a technique used to solve a problem based on a set of many facts. The linear technique makes decisions based on a complex mathematical formula applied to the variables. If the process and its results were displayed graphically, they would be viewed as a bunch of data points on a two-axis graph with a line drawn to "fit" the points. Fortunately, you don't have to know a lot about it to work with it.

PRODUCT APPLICATIONS Linear programming has many applications, including determining the most profitable volume of products to make and the right product mix for manufacturing companies. When you optimize for product mix, the results displayed include total profit achieved, the priority of each objective, and the number of units required to achieve the objective.

The program includes two other useful bits of information, "slack" and "shadow price." Slack is best defined as "leftover" components—those that are not used because there was not enough of another component to make a complete product. Shadow price indicates how much total profit could be increased if the number of

individual components were increased.

Constraints are the limits placed upon your ability to produce a product. For example, Product X uses one gallon of blue stuff, two gallons of red stuff, and three gallons of yellow stuff. The quantities on hand of the blue, red, and yellow stuff are temporary constraints placed on your ability to produce Product X.

Limits on the ability to achieve a certain result are not only inventory- or product-related. Labor hours available, storage space utilization, and machinery time are a few additional examples of variables you might evaluate in maximizing the objective.

Another module that works along with *Optimal Solutions-Plus* is the what-if module. This program first lets you answer questions such as: If maximizing profits is an objective, how many of Product X should be produced if we had 40 gallons of red stuff instead of the 36 gallons currently in stock? The answer might be that there is no benefit.

In addition to product-mix problems, there are other kinds of financial and nonfinancial models this program is suited to solving. Although it doesn't do a lot of different things, it performs optimization analyses very well and with little effort.

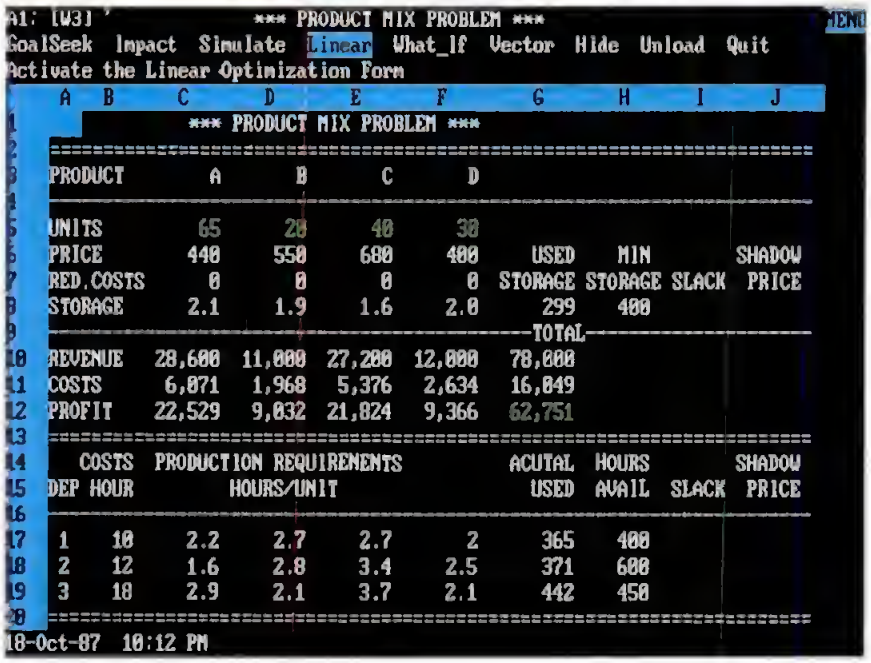
Simulated Solutions-Plus is designed to help make assessments using risk analysis, or Monte Carlo simulations. It helps make decisions about the future without extensive, time-consuming, and often blind what-if manipulations within spreadsheets.

Forecasting of this type is used to simulate uncertain variables and determine a likely objective within the constraints given. These simulations are aided by assigning probabilities to certain of the variables. The variables can be thought of as the "path" taken to achieve a particular objective. Some of the elements on this path are the anticipated price of a new product, probable number of unit sales, and production costs.

To be most effective, this kind of planning requires considerable brainstorming for information about the intended marketplace, expectations about potential product acceptance, expected price ranges—the stuff probabilities are made of.

Once a model is built, *Simulated Solutions-Plus* will furnish you with a probability distribution of your goal. When you place the results in the worksheet, *1-2-3* (or *Symphony*) can graph the results for you, and déjà vu! The bell curve we saw in Statistics IA.

Goal Solutions-Plus *gives you the ability to set a desired goal and solve for the variables within the formula that yield a particular result. Command control is through function keys.*



Optimal Solutions-Plus *is a decision tool for linear programming. The program includes a what-if module and follows the* 1-2-3 *moving-bar menu conventions.*

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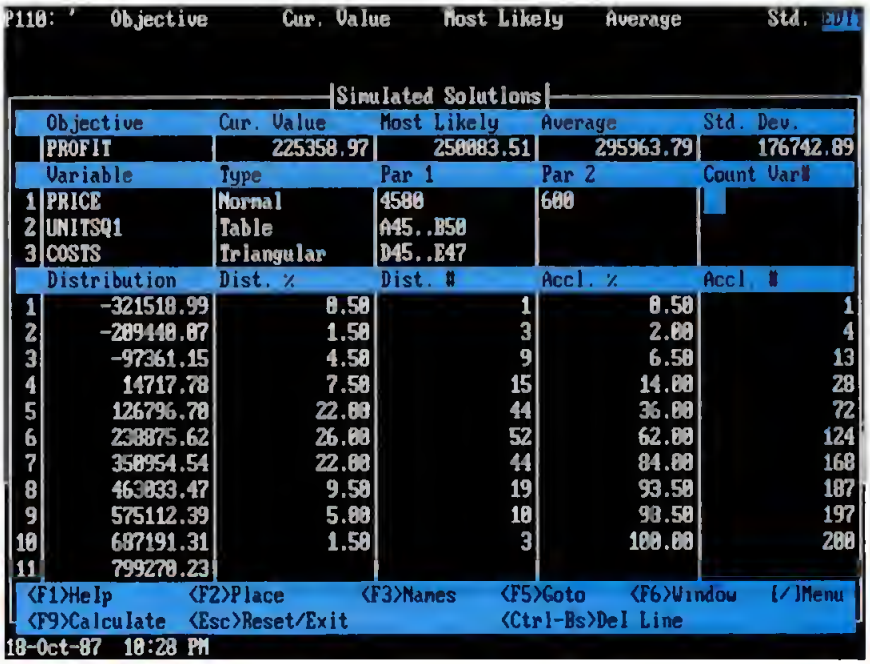

Simulated Solutions-Plus *is designed to help make assessments using risk analysis or Monte Carlo simulations. These simulations are aided by assigned probabilities to certain variables.*

Of all the Enfin modules reviewed here, *Simulated Solutions-Plus* takes the greatest amount of processing time to calculate a result. The reason it takes so long is because the program performs 200 simulation runs. Of the 200 runs performed, it displays an array of ten results, which include the number and frequency of occurrence for each objective derived.

As in *Goal Solutions-Plus*, *Simulated Solutions-Plus* contains the impact and sensitivity-analysis tools that help you to take advantage of the most favorable course of action.

Simulated Solutions-Plus is truly a futuristic analytical tool, designed for planning projects that have no historical data on which to rely. Of all the modules, it seems to be the one that requires the most expertise in marketing and, perhaps, statistics. It might also take the greatest amount of time to learn, but, once learned and applied, it can be rewarding.

With this group of products, Enfin Software Corp. has given us some really powerful forecasting tools. They are easy to use and well documented, with good examples and tutorials.

—William H. Stewart

Wisard

Wisard, a $99 program from Shade Information Systems, is an effective forecasting tool for use with *Lotus 1-2-3*, Release 2.0 or 2.01.

A beta version, scheduled for release as Version 3.1 by the end of 1987, was evaluated for this review. Improvements to the new version include more-extensive documentation, tutorials, and a better explana-

PC MAGAZINE FACT FILE

Wisard
Shade Information Systems Inc.
P.O. Box 19730
Green Bay, WI
54307-9730
(414) 436-2341
List Price: $99

Requires: 640K RAM; *Lotus 1-2-3*, Release 2.*x* or *Symphony*; DOS 2.t or later.

In Short: A single forecasting tool that operates by combining results of several forecast techniques. Not copy protected.

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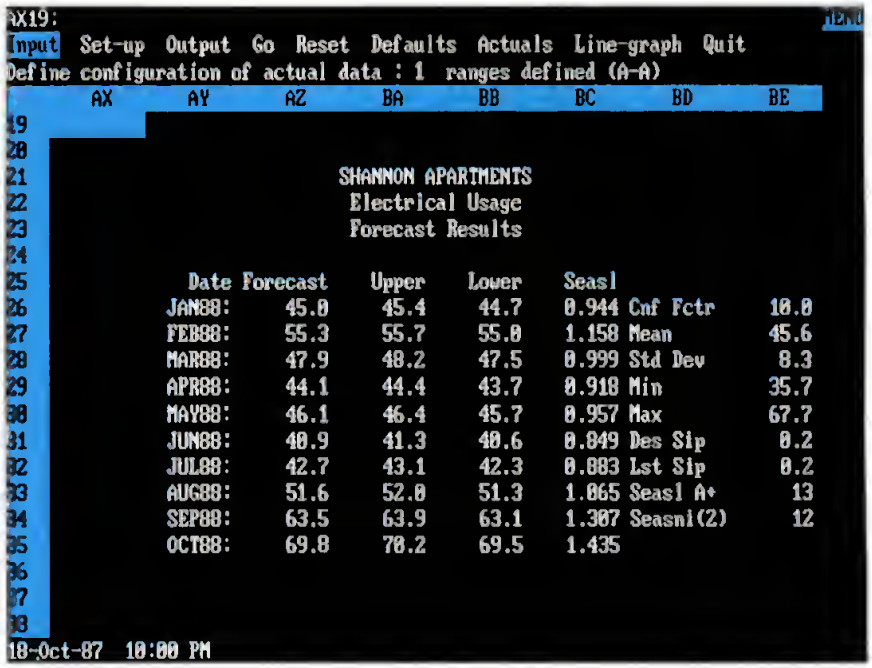
■ LOTUS 1-2-3 ADD-INS



Wisard *combines four statistical analysis techniques for planning and forecasting. The program attempts to identify seasonality in data and project results accordingly.*

tion of the program's methodology. There's also a reference section containing explanations of the statistical techniques used in the package.

This program shouldn't be difficult for users familiar with *1-2-3*. The only drawback is that the *Wisard* program must be loaded into memory before starting *1-2-3*. Then, using an Alt-function key combination (defined in the Lotus Add-In Manager), *Wisard*'s identity as a separate program becomes relatively transparent.

On-line help is a little sparse. For example, the help entry for the Input command consists of only a few words about Input in general and some brief commentary about how to select commands. Underneath the Input command are two commands ("Take-out" and "Put-in"), but there is little information on their impact or use.

Wisard combines four different statistical forecasting techniques that deal with historical data in various ways. The program attempts to identify any seasonality to the data and to project the results accordingly. Besides projecting results, the program gives you information about things like standard deviation and confidence levels of the results.

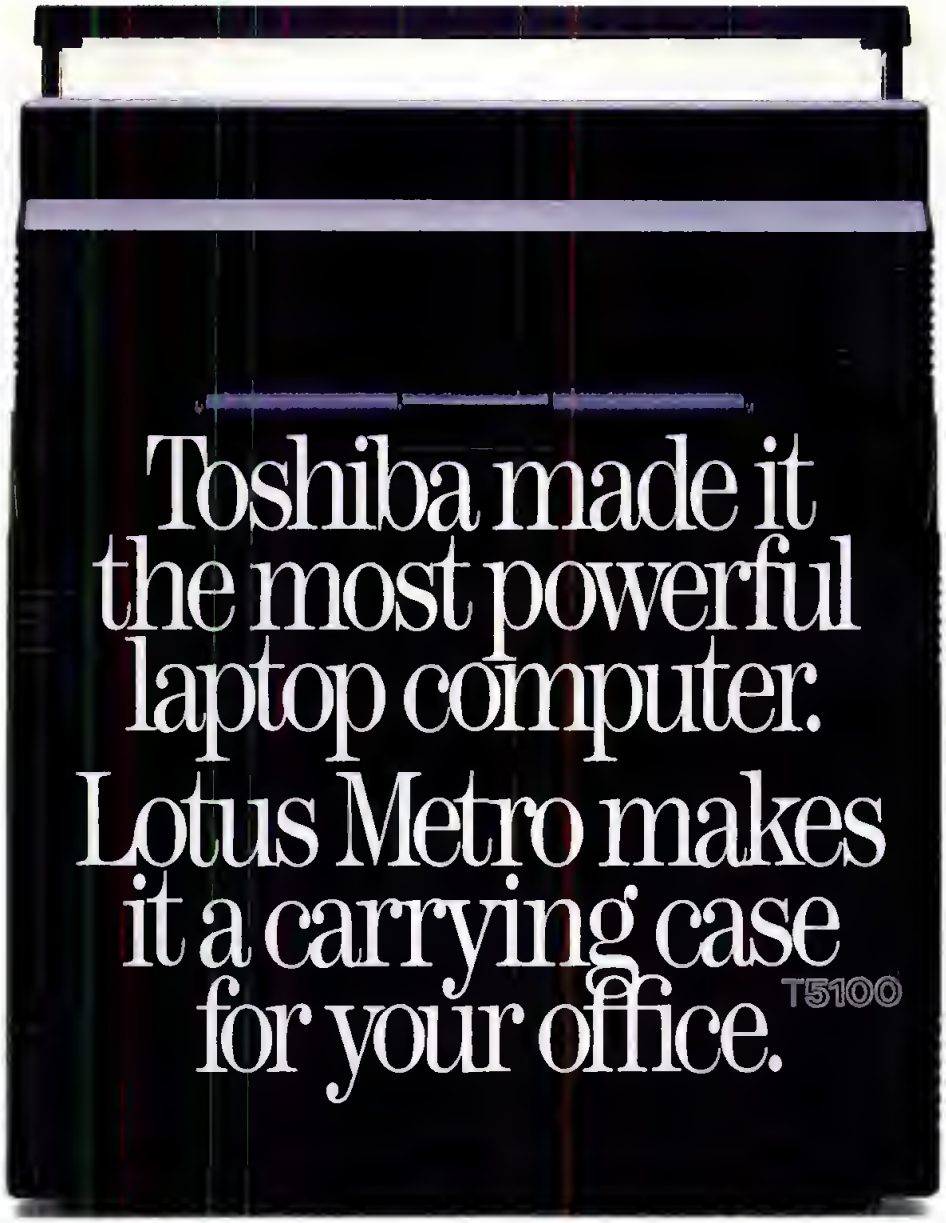
Control over such things as starting observation within the input range, as well as the number of observations to forecast, are left to the user within a setup screen.

Data used as input for *Wisard* is selected by "pointing," as in *1-2-3*, or defining ranges. All data must be contained in the worksheet. But be careful, at the worksheet level, to exclude data that is not representative of the past, or it will have an adverse impact on the forecast.

Forecast results may be presented in two ways. You can simply display the numbers forecast, or, perhaps more meaningfully, you can combine the results of the forecast with statistical data that includes upper and lower limits, a seasonal factor, and other statistical information. Both are placed in output ranges defined in a range within your worksheet.

As with all forecasting techniques, judgment about events which had an impact on the past, as well as superior insight about events which may have an impact on the future, plays a significant role in the accuracy of a forecast.

The *Wisard* forecaster makes useful estimates of future results and, at $99, seems a good value.—**William H. Stewart** PC



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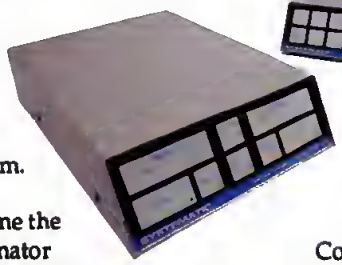
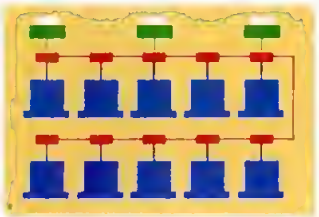


In effect our system will become the common denominator by which all your equipment can connect, in any configuration and location you desire, now and in the future.



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18 WAYS TO SHARE YOUR PERIPHERAL

Sharing devices solve the problem of how to make one laser printer or modem work for the entire office.

Remember when you convinced your boss to get that first laser printer? Yep, you spent big bucks, but the output was better than anything you had ever produced. Soon, everyone was hauling floppies over to your PC, asking you to print "just one more short letter." You couldn't just hog the laser, but you weren't getting your work done either. A T-switch partially solved the problem, but the constant requests for switching from one printer to another were still annoying. Then you tried some of the early automatic printer sharing devices, and they worked pretty well. Most of the time. After a few complaints, you got an electronic T-switch and you waited for technology to catch up.

Well, if you gave up back then, it's time to dive back into the market, because there is a pack of good printer sharers and device sharers now available. Even though laser printer prices are continually dropping, it's still cheaper to share a laser than to shell out for two or three of them.

Now you have a variety of options available for sharing devices. The tried-and-true T-switch has dropped in price below $100 and, with inexpensive cables available, it's still a good choice for the small group. Printer sharers receive data through varying numbers of serial and parallel connections and automatically switch output to a preselected device. A newer invention, the device sharer, routes ports to printers, modems, plotters, and other PCs. For sharing of peripherals and disk storage, a local area network will often fill the need.

Most printer sharers accept from 3 to as many as 24 serial inputs at speeds from 300 to 9,600 bits per second. The more powerful sharers will also provide one or more parallel input ports, but seldom more than two or three. In some cases, the device will also convert serial input to parallel output and allow connection to a second sharing device, increasing your network of available printers.

The device sharers take printer sharing one step further and come very close to a networked environment. Both serial and parallel input ports are available, and the

data coming through the device can be relayed to any parallel output ports or serial ports. PCs can share modems and even hook up to other PCs using a communications program, allowing file transfers at 19,200 bps and sometimes higher. Additional devices can be added easily to the configuration since few of the ports are dedicated to printer output only.

Most sharing devices have a RAM buffer for holding data until the desired port is free. The minimum memory provided is usually 256K with some devices going to 2MB or higher. Although some devices lock onto a port and store data until the job is done, the more powerful sharers accept simultaneous inputs from many ports at once, automatically keeping track of what data came from where and queuing it to the printer on a priority basis.

You can expect quite an array of standard features in today's sharing devices. Communications parameters, once set only with DIP switches, can usually be changed through software controls and modified uniquely for each input and output port. Handshaking protocols, the method by which one device tells another that it is busy, can be set using XON/X-OFF (characters that indicate busy or not busy), a hardware signal, or both. Many sharers let you automatically send a form-feed character (new page) at the end of each print job as well as a beginning-of-job header, end-of-job header, and reset codes to start each operation.

■ Bay Technical Associates' Print Master 710F accepts input from all ports simultaneously and buffers up to 21 print jobs in the 512K supplied with the device.

To ensure that reports don't start printing on top of each other, the sharer must have a way to determine the end of the job. By establishing a time-out period, the length of time the device should wait before switching to another port, you can force jobs to complete after a certain amount of activity. Depending on the sharing device, these periods can range anywhere from 0 seconds to an indefinite period of time.

Cabling the devices to each other is not difficult. You will need many cables, one from each PC to the device and one from the device to the printer. The manufacturers are not consistent in their requirements, so you should read the manual thoroughly before you buy cables. Some devices will require null modem cables, cables that rearrange some of the pins, while others require straight-through cables that pass signals to the same pins intact. Some cables use 25-pin (DB-25) connectors, while others use 9-pin (DB-9) or phone jack (RJ-11 and others) connections.

Most of the sharers have DIP switches that set up the basic configuration options for the sharer. In addition, some have push buttons on the front panel that you can use to make changes to the original settings. The more capable devices give you a simple command language that you can use to send changes to it. Each command is preceded by a sequence of characters that instructs the device to interpret what follows as a command. Finally, some manufacturers provide utility programs and memory utilities that make configuration changes a breeze.

Buying a printer sharer or device sharer is much like buying a VCR. You can look at features until you've had enough, and there are still five models that look good. Before you buy a device, sit down and sketch out the kind of connections you really want. Plan for future capabilities and anticipate new peripherals that you might add to your configuration. Then read what follows, select a few candidates, and ask your local dealer for a demo.

Most of the manufacturers represented in this review sell a variety of printer-sharing devices. We asked each company to submit its midrange model for evaluation. Information on full product lines is available from the vendors. Reviews are arranged in alphabetical order by company name.

BAY TECHNICAL ASSOCIATES INC.

Print Master 710F

The Print Master 710F is one of 11 printer sharers offered by Bay Technical Associates to help you control your printer resources. The 710F comes with four parallel and six serial ports that can be configured as either input or output ports. Measuring about 10 inches square and 3 inches tall, the unit is surrounded by a sturdy metal case and powered by an internal power supply.

All ten ports on the back of the 710F use female DB-25 connectors, and you hook your PC to the unit with female-to-male, straight-through cables. Ports 1, 2, 5, and 6 are parallel ports and can be connected to a printer with a standard male to Centronics printer cable. Serial devices are connected to the sharer with male-to-male, straight-through cables. The front panel of the 710F has a green power light and ten status lights, one for each port, that glow when the port is active.

The 710F comes from the factory set with parallel port 1 as a printer and the other ports as input devices. To change these settings, you connect your PC serial port to port 10 on the unit. Although Baytech supplies a simple terminal emulation program, you can use any communications package to interact with the 710F. The unit responds with a simple menu from which you can change the configuration. You can change baud rates and handshaking proto-

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Print Master 710F
Bay Technical Associates Inc.
Data Communications Products Division
200 N. Second St.
Bay Saint Louis, MS 39520
(800) 523-2702
(601) 467-8231
List Price: With 512K, $995; with 1MB, $1,244.
Requires: Serial or parallel port.
In Short: A capable printer sharer with the ability to handle a large number of serial and parallel devices.

CIRCLE 699 ON READER SERVICE CARD

Photographs Thom O'Connor

The Print Master 710F from Bay Technical Associates comes with four parallel and six serial ports that can be set up as output or input ports. Pop-up utility software is also included.

cols on the serial ports and set the ports as inputs or outputs. In addition, you can assign a logical name to each port as a reference.

The configuration program is also used to change settings that affect every port. The time-out period for the 710F can be changed from the default value, 20 seconds, to a value from 0 to 200. It can also send a header message of 80 characters before each print request, and it can add a form feed on the beginning, the end, or both ends of a print request. The printer code used to switch output ports can also be modified. If you only have one printer, the 710F will automatically route the output to a single port. With multiple printers, you set up a default output port, but you can switch to another port with a printer code followed by the port number. The default code, $PRINTER, can be sent with any word processor or with a memory-resident, pop-up utility program supplied with the unit. To select a different printer, you hit Ctrl-Tab to pop up the utility menu and use the function key assigned to the name and port of the printer that you want.

The 710F accepts input from all ports simultaneously and buffers up to 21 print jobs in the 512K supplied with the device. The buffer is expandable to 1MB and each port can use as much memory as is needed to complete the job. The 710F can also handle both hardware and XON/XOFF protocols. When data is sent or received on a port, the red status light glows, indicating that activity has occurred. The light will remain lit until the print job has been completed for the port.

The user manual is easy to read and full of valuable information. Cabling requirements and pinouts are addressed in simple terms and sample cable diagrams are provided. The manual thoroughly describes both the configuration options and the utility programs used to make the changes.

The 710F is quite versatile, and a few additions would make it even better. One

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CIRCLE 260 ON READER SERVICE CARD

time-out period is used for all ports, and there are times where one printer needs a long time-out while another doesn't. The form-feed setting also affects all ports, and there are times where a transaction printer doesn't need a form feed while a draft printer does. The terminal emulator could go one step farther and just connect with the unit instead of requiring you to initiate the transmission. Even without these items, the 710F is still a flexible unit.

Baytech has put together a nice product in the 710F. The instructions are easy to follow, and the device is simple to configure and use. If you've got a number of people who need to share a couple of printers, then Baytech's offering is well worth considering.

Black Box Corp.'s Expandable Print Sharer PI210 and Serial Expansion PI212 are simple devices ideal for situations where two or three PCs need to share a printer.

BLACK BOX CORP.

Expandable Print Sharer PI210
Serial Expansion PI212

True to its name, the Expandable Print Sharer PI210, from Black Box Corp., is a small black printer-switching box that accepts four parallel inputs and sends them to one parallel output. The PI210 has four female DB-25 connectors on its slanted top, one female DB-25 output port on its left side, and one male DB-25 connector on its right side for adding more ports. You can connect up to three PI210s to add four more parallel ports, or three PI212s to add four more serial inputs. Each box connects to the other by attaching the male DB-25 on the right side of the unit to the female DB-25 on the left side of the expansion box.

The PI210 runs off a 20-watt transformer attached to the front of the unit. There is a red light for each port to indicate activity, a green power-on light, and one that shows that the port is busy. The PI210 has no buffers or software control commands; all configuration settings are made using jumpers and DIP switches.

To get inside the PI210 or PI212, you take off the rubber feet and slide the box away to expose the circuit board. You can set a time-out period of 2, 4, 8, 16, 32, or 64 seconds and enable the sending of a form feed after each job, settings that affect all ports. On the PI212, you also use a jumper and a set of DIP switches to set parity and baud rates from 300 to 19,200 for all ports. However, each port can be individually configured to add a line feed to every carriage return and to control the hardware handshaking signals.

You connect your computer's parallel ports to the PI210 with male-to-male, straight-through cable. The parallel output ports take a standard male DB-25-to-Centronics cable to your printer. To hook up serial ports to the PI212, use female-to-male, DTE-to-DCE DB-25 cables. When you send data to the PI210 or PI212, it locks onto the active port and sets all others as busy until the port completes its transmission. After the time-out period has expired, the device moves from the lowest-numbered port to the highest-numbered port, searching for the next active one to select.

The PI210 and PI212 are simple devices requiring little documentation. The manual succinctly describes the jumpers and DIP switch settings for each device. In the back of the 15-page manual are specifications and pinouts for both parallel and serial ports.

Don't expect a lot from these devices—after all, you're paying only $279. You need to understand some of the communications terms before you open the box and start setting DIP switches. There are no buffers, so each port must wait until another port gives up the printer. The time-out period applies to all ports, so you can't temporarily lock onto a printer if you should need to.

But if you have only limited requirements, say, two or three PCs sharing one printer, these devices might just do the trick. And at $279 and $259, respectively, the price is hard to beat.

FACT FILE

Expandable Print Sharer PI210
Serial Expansion PI212
Black Box Corp.
P.O. Box 12800
Pittsburgh, PA 15241
(412) 746-5530
List Price: PI210, $279; PI212, $259.
Requires: Parallel or serial port.
In Short: A simple printer switch that shares serial and parallel ports with a single parallel output.

CIRCLE 688 ON READER SERVICE CARD

Your logical choice for printer & data sharing.

It's your choice.
Now you can give every PC user in your office *freedom of choice:* the choice to send their output to any printer — serial or parallel — anytime.
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Just "pop-up" the *memory resident* switching menu, cursor-point to the device you want to switch to, and press *ENTER*.
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Preset configurations.
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The Logical Connection lets minicomputers and mainframes share peripherals with PCs. Or, let many devices share a single expensive modem connection.
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PC MAGAZINE EDITORS' CHOICE

In April, 1987 *PC Magazine* named **The Logical Connection** "Editor's Choice among *all* printer sharing devices reviewed." Author Winn L. Rosch called it "... more than logical — maybe inspired!"

An easy choice.
The Logical Connection is easy to set up and easy to use. Best of all, it's easy on the pocketbook. For price performance and ease of use, nothing else even comes close.
So if you're looking for the *best* way to share your valuable computers and peripherals, there's only one logical choice. Get the logical connection today.
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CIRCLE 286 ON READER SERVICE CARD

BUFFALO PRODUCTS

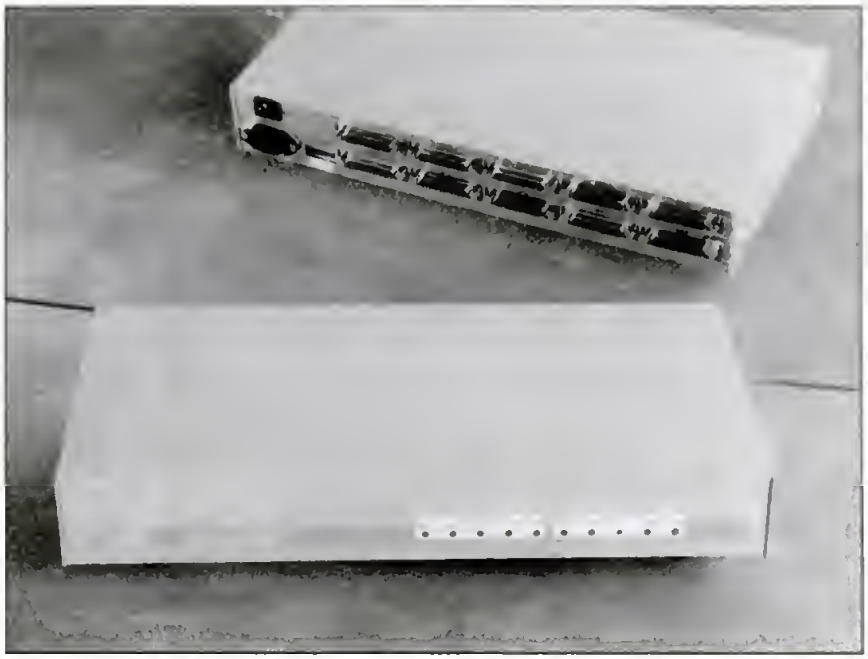
Buffalo SX-1000

The Buffalo SX-1000, from Buffalo Products, is a device that combines the features of a printer sharer and a device controller. Sporting five parallel ports and five serial ports, the SX-1000 is a compact device standing only 3 inches tall and 15 inches wide. On the front of the attractive metal case, you'll find ten status lights that glow green for input ports and red for output ports. On the back, you'll see ten female DB-25 connectors and a DIP switch for setting device defaults.

Although there are ten ports on the unit, only one parallel port (2) and four serial ports (5,6,7, and 8) are configurable as either input or output ports. Parallel ports 0 and 1 are set up as input ports, with parallel port 4 and serial port 9 designated as output-only ports. You can connect your PC to the device's parallel ports with male-to-male, DB-25 straight cables, and to its serial ports with the same cable you would use to hook up a printer or modem. On the output side, you again use the same cable that you would use to hook up to a printer or modem for both types of ports.

The SX-1000 port configurations are set through DIP switches and software control. To change the configuration, you set switch 1 to supervisor mode and turn automatic form feed on or off, set the default output channel to parallel port 4 or serial port 9, and configure ports 2, 5, 6, 7, and 8 as input or output ports. You then set switch 1 back to normal to activate the new settings. All other settings must be made using software codes or a pop-up, memory-resident program called the *SX Manager*. The software codes must start with a three-character sequence, "@bF", contain a command, and then finish with a semicolon.

■ The SX-1000 is a flexible device sharer with basic capabilities and few shortcomings.



The Buffalo SX-1000 has five serial and five parallel ports and is equipped with 256K of memory, upgradable to 1MB. Ten status lights on the front of the unit monitor activity.

Commands for changing the baud rate from 300 to 9,600, resetting the time-out period from 0 to 60 seconds, and naming ports must be sent through channel 5, the supervisor port. The commands that can be sent to other input ports include selecting a new output port, establishing a bidirectional port for modem transfers, and dedicating one input port to an output port. Any input port can be routed to any output port and up to nine buffers can be daisy-chained from either serial or parallel ports.

The SX-1000 comes with 256K of buffer memory, which can be upgraded to 1MB of buffer memory in increments of 256K. The power supply is built into the device so you only need the 120-volt AC wire to power up the unit.

The manual has only about 30 pages, but it covers all the issues quite well. For the impatient user, there is a one-paragraph description of the purpose, installation, and use of the SX-1000, enough for the expert user. The rest of the manual clearly and methodically describes the setup and operation as well as the use of the commands and software programs. The last two sections contain detailed discussions of parallel and serial pinouts for various devices.

The SX-1000 is a flexible device sharer with basic capabilities and few shortcomings. PCs close to the unit can maintain the high speeds gained with parallel input and output, while more remote PCs can still connect and share the resources. It's a good device to use if you've got a mix of printers and devices that will be shared by a growing group of users.

PC MAGAZINE FACT FILE

Buffalo SX-1000
Buffalo Products
2005 Devereux Dr.
Burlingame, CA 94010
(800) 345-2356
(415) 697-6249
List Price: With 256K, $625; with 1MB, $625.
Requires: Serial or parallel port.
In Short: A versatile device sharer with good expansion capabilities and a low price.

CIRCLE 097 ON READER SERVICE CARD

Everything it takes to add PostScript to your LaserJet II, including HP's blessing.

Hewlett-Packard® and QMS® have made it easy to give your LaserJet Series II® the desktop publishing power of the PostScript® page description language.

The new QMS JetScript™.

JetScript is the only Adobe PostScript controller upgrade authorized by HP and designed specifically for the LaserJet Series II. JetScript gives your printer the industry-standard page description language to accompany HP's PCL printer language. This expands your laser printing capabilities. Increases overall printer performance. Yet preserves HP functionality and warranties.

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The result is a PostScript system with 35 resident Adobe typefaces, three megabytes of RAM, and QMS ASAP™ (Advanced System Architecture for PostScript) proprietary technology for superior performance. All for less than half the cost of a new PostScript laser printer.

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Simply, PostScript opens up the full range of possibilities for desktop publishing. You have complete control over the final look of the page, down to the last exacting detail. PostScript allows for an infinite number of font variations and sizes. That makes PostScript's limitless flexibility and power the perfect complement to your LaserJet Series II, giving you the high-quality output you require.

Impressive results People have come to expect impressive results from QMS—one of the first companies to bring the power of PostScript to laser printing, and now with more PostScript-based products than any other company.

You'll get the same results from the new JetScript. After all, it has HP's blessing.

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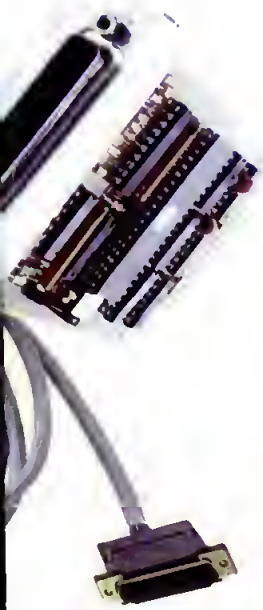
**JetScript available for IBM PC-XT™, IBM PC-AT™, HP Vectra™ and compatible personal computers, or the IBM PS/2™ Model 30.*



LASER CONNECTION™

A QMS® Company

CIRCLE 178 ON READER SERVICE CARD

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DIGITAL PRODUCTS INC.

LaserBoard PrintDirector MS-10SP PrintDirector Jr.

Digital Products markets a wide range of device-sharing equipment. Three products of particular interest are its new LaserBoard, for the HP LaserJet Series II, and its PrintDirector MS-10SP and PrintDirector Jr., more-conventional printer sharers.

LASERBOARD The LaserBoard plugs into the I/O slot on the side of the Series II and gives it the capability to share three serial printers. The LaserBoard also comes with 256K for buffering print requests. Attached to the board is a male DB-25 connector that you plug into the printer's serial port and three connectors that can be configured as RJ-45 or female DB-25 connectors. You connect your PC to the printer with a male-to-female straight-through cable. All ports on the board are set permanently for 9,600 bps. The board is preset for both hardware and software handshaking, a 20-second time-out period, and an automatic page eject at the end of the job if the last character is not a form feed.

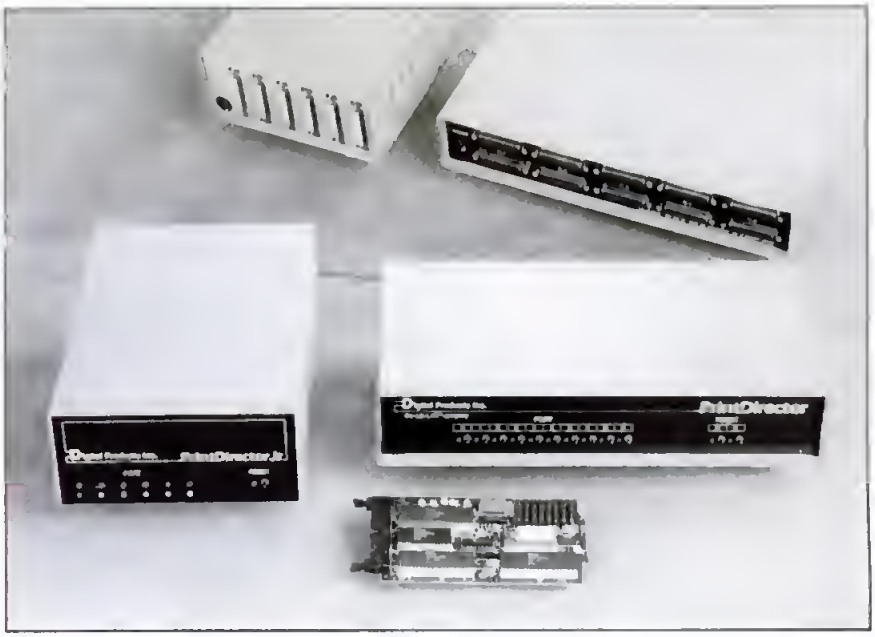
The LaserBoard can be configured using software control codes or a memory-resident, pop-up utility program. The board has two modes: a transparent mode, in which all output is sent to the printer, and a command mode, in which codes can be sent to change the printer's options. Before you can use commands, you send 40 plus signs (+) followed by an exclamation point to put it in command mode. Commands start with two Ctrl-T's (TT), and they only affect the port indicated in the command string.

Each port can be set for a time-out period of 0 seconds to 255 minutes. You can also load a string of 40 characters to be sent at the beginning of each print job and another one for the end of the job. After sending commands, you should return the board to transparent mode by sending two Ctrl-T's and a G (TTG).

The pop-up utility lets you select a custom hotkey and change some options on the LaserBoard. With the printer features choice, you can send the LaserJet the escape sequences for switching it to one of seven built-in fonts or three cartridges. The copy function sets the number of copies, from 1 up to 65,536. You can assign the port a high priority, so its jobs are printed right away, or a low priority, which instructs it to wait for other jobs to finish first. The control functions can set a time-out of 20 seconds or 1, 4, or 20 minutes. You can also cancel the most recent print job and force a job to start printing immediately instead of waiting for a time-out.

Although there aren't many features to discuss, the documentation covers the LaserBoard quite well. The text covering the installation is easy to follow, and there are special notes that help you better understand a point. The command section explains the control codes adequately, but it could use examples to describe some of the technical details about the use of embedded characters. Cabling requirements are explained briefly in an appendix.

The pop-up utility is handy, but Digital Products could enhance it to make better use of the LaserBoard commands. It limits the time-out periods to four choices instead of asking for the period you desire. It could ask for starting and ending job strings and eliminate the need for the Ctrl-T's. When the printer function changes the fonts, it



New from Digital Products: the LaserBoard (foreground), which fits inside HP LaserJet Series II printers, and the PrintDirector Jr. and PrintDirector MS-10SP for conventional sharing.

PC MAGAZINE FACT FILE

Digital Products Inc.
108 Water St.
Watertown, MA 02172
(617) 924-1680

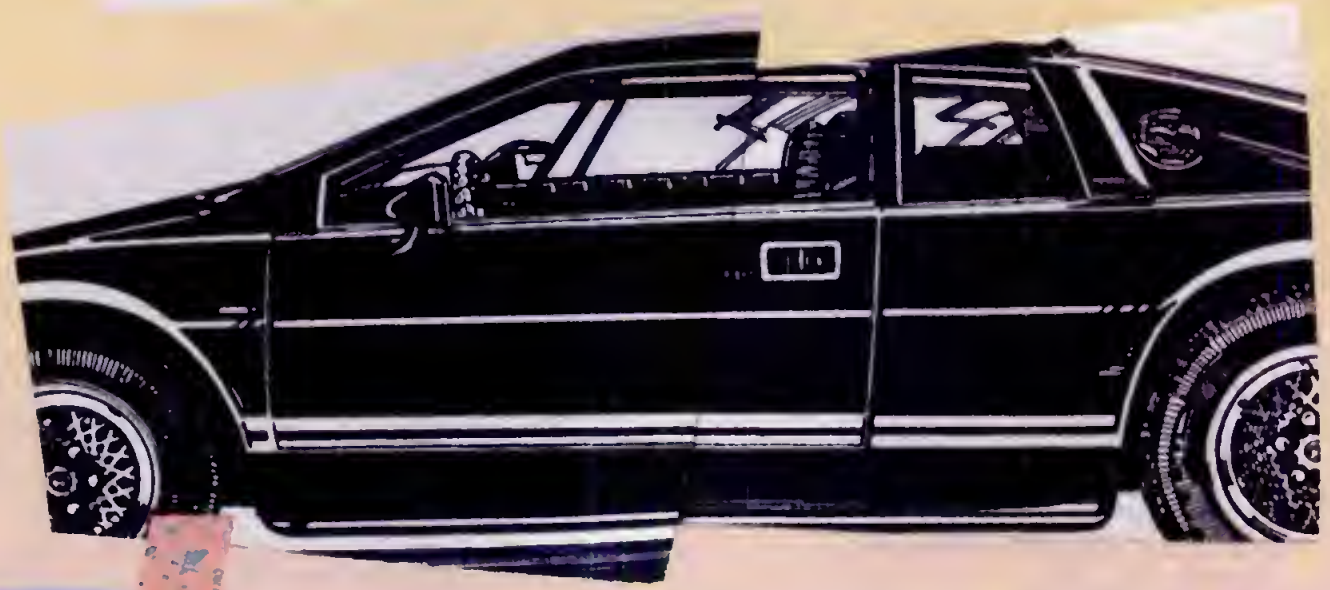
LaserBoard
List Price: $495
Requires: Empty I/O slot on the HP LaserJet Series II.
In Short: A circuit board that adds three-port printer sharing into the HP LaserJet Series II.
CIRCLE 696 ON READER SERVICE CARD

EDITOR'S CHOICE

PrintDirector MS-10SP
List Price: $1,395
Requires: Serial port.
In Short: A powerful printer sharer with both serial and parallel ports and tremendous flexibility.
CIRCLE 695 ON READER SERVICE CARD

PrintDirector Jr.
List Price: $495
Requires: Serial port.
In Short: A printer sharer with a fixed configuration that is easy to set up and use.
CIRCLE 694 ON READER SERVICE CARD

These unretouched print samples show the superior print quality of QMS-PS 810 over printers using first-generation print engines.



ntroducing the PostScript laser printer that blacks out at high speeds.

The new QMS-PS® 810 can compose and print the most complex pages in record times, with richer, more saturated blacks than ever before. All with the desktop publishing power of Adobe PostScript®, and the superior print know-how of QMS, an industry leader.

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The QMS-PS 810 laser printer is easy to use, maintain, and comes with a one-year warranty. It's available from Laser Connection dealers. Laser Connection is a sales and marketing subsidiary of QMS. For the dealer nearest you call **1-800-523-2696**.

LASER CONNECTION™

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CIRCLE 258 ON READER SERVICE CARD

Device Sharers: Summary of Features

(Products listed in ascending price order)

	Black Box Corp. Serial Expansion PI212	Black Box Corp. Expandable Print Sharer PI210	Intellicom Inc. Mega-Link	Vie-West Inc. Vie-West CA-4	Digital Products Inc. Print-Director Jr.	Digital Products Inc. LaserBoard	Extended Systems Inc. ShareSpool ESI-2001 for the LaserJet	Fifth Generation Systems Logical Connection	Buffalo Products Buffalo SX-1000
	$259	$279	$349	$450	$495	$495	$495	$495	$625
Size (HWD in inches)	2 × 6.6 × 6	2 × 6.6 × 6	2 × 6.5 × 9.5	3.1 × 6.5 × 9	3 × 10.75 × 6.75	3 × 6.5 × 0.5	1.1 × 3.25 × 7.82	12 × 4 × 1	2.25 × 14.6 × 10
Standard input ports	4 serial	4 parallel	2 serial, 1 parallel	4 serial	5 serial	3 serial	3 serial	4 serial, 2 parallel	2 parallel
Standard output ports	0	1 parallel	2 serial, 1 parallel	0	1 serial	1 serial	1 serial	4 serial, 2 parallel	1 serial, 2 parallel
Max. no. of serial ports	4	12	2	16	6	3	3	4	5
Max. no. of parallel ports	0	16	2	0	0	0	0	4	5
Standard buffer size	0	0	256K	0	256K	256K	256K	256K	256K
Max. buffer size	0	0	1MB	0	512K	256K	256K	512K	1MB
Time-out period	2–64 seconds	2–64 seconds	0–10 seconds	1–13 seconds	20 seconds	2–254 seconds, 2–254 minutes	1–255 seconds	0–255 seconds	0–60 seconds
Type of flow control	Hardware handshaking	Hardware handshaking	Hardware handshaking, XON/XOFF	XON/XOFF	Hardware handshaking, XON/XOFF	XON/XOFF	DTR	XON/XOFF	CTS/DTR, XON/XOFF
Cables supplied	None	None	None	None	None	Four 1-ft. cables	None	None	5-ft. serial cable

—Indicates Editor's Choice

erases the starting job strings, forcing you to reset it each time. With the LaserBoard, you are limited to three serial ports and a 256K buffer. For a little more money, you should be able to find a desktop printer sharer that can use the speed of the Series II parallel port while accepting both serial and parallel input. In addition, many shares are able to expand their printer buffer to 1 or 2MB of memory and share multiple printers.

The LaserBoard does a good job of extending the capabilities of the Series II to three PCs. It's simple to use and takes no room on your desktop. If your needs are small and sharing three PCs is enough, the LaserBoard should perform well for you.

PRINTDIRECTOR MS-10SP Not content to stay with its diverse product line, Digital Products has released yet another printer sharer, the PrintDirector MS-10SP. Housed in an attractive blue cover measuring 2¼ by 8 by 12¼ inches, the MS-10SP has six serial ports and four parallel ports that can be configured as either input ports from a PC or output ports to a printer. The unit comes with 256K of buffer memory and is upgradable to 1MB.

There are 12 status lights and push buttons on the front of the MS-10SP: one for the reset button, one for the status button, and one for each of the ten ports. On the rear of the unit are two rows of five ports, all with female DB-25 connectors, and a connector for the external 53-watt power supply.

The MS-10SP comes configured with ports 0 through 8 sending data to port 9, a parallel port, as the default printer. Connect PCs and printers to the device DB-25 straight-through cables, female-to-male for PCs and male-to-male for printers.

The front panel serves many functions for the MS-10SP. To erase the most recently sent job, just press the button for the sending port. You can cancel more jobs by pressing the button once for each job to erase. To cancel all jobs for one printer, push the button for the port assigned to it, and to cancel all jobs in the device, just press the reset button. When you send a document, both the input port and output port lights glow steadily until the entire job is stored in the buffer. If a printer is busy, the input port will blink slowly, indicating that a job is waiting to be printed.

The MS-10SP comes ready to use, but to access all of its features you need to change the configuration. This can be accomplished by using the push buttons, a dumb terminal, or your PC and a software package. You prepare the MS-10SP for all

	Quadram Corp. Microlazer VI	Rose Electronics Master Switch	Integrated Marketing Corp. Data Manager Data Net 1551	Server Technology Inc. EasyPrint EP-700	Bay Technical Associates Inc. Print Master 710F	Extended Systems Inc. ShareSpool ESI-2076	Digital Products Inc. PrintDirector MS-10SP	Western Telematic Inc. Lasernet Model PSU-82C	Giltronix Inc. Giltronix EZ Queue 3326
	$895	$749	$795	$899	$995	$995	$1,395	$1,695	$3,220
Size (HWD in inches)	12.25 × 8 × 2.25	10.5 × 3.5 × 5	2.5 × 14.05 × 10.75	7 × 5 × 1	10.12 × 8 × 3	2.5 × 8.5 × 13.5	2.25 × 8 × 12.25	12 × 3.5 × 9	4 × 19.5 × 11.7
Standard input ports	4 serial, 2 parallel	9 serial, 9 parallel	5 serial	7 serial	Flexible	7 serial	Up to 8 serial, up to 4 parallel	6 serial	24 serial
Standard output ports	4 serial, 2 parallel	9 serial, 9 parallel	1 serial	2 serial, 2 parallel	Flexible	1 serial	Up to 6 serial, up to 4 parallel	1 serial, 1 parallel	24 serial, 2 parallel
Max. no. of serial ports	4	9	6	8	6	7	6	9	24
Max. no. of parallel ports	2	9	0	2	4	0	4	1	2
Standard buffer size	256K	256K	256K	Unlimited (uses hard disk)	512K	256K	256K	256K	2MB
Max. buffer size	1MB	1MB	1MB	Unlimited (uses hard disk)	1MB	2MB	2MB	2MB	2MB
Time-out period	20–200 seconds	1–255 seconds	1–255 seconds	User-defined (uses hard disk)	0–200 seconds	1–255 seconds	2–254 seconds, 2–254 minutes	.25–300 seconds	1–999 seconds
Type of flow control	DTS/DTR, XON/XOFF	DTR/DSR, XON/XOFF	DTR/PIN20, XON/XOFF	CTS, DTR, RS 232	CTS/DTR	DTR, XON/XOFF	Hardware handshaking, XON/XOFF	DTR/data, XON/XOFF	CTS/RTS, DTR/DSR
Cables supplied	None	Two 10-ft. cables	None	Four 30-ft., two 6-ft. cables	None	None	None	None	6-ft. cable

changes by holding down the reset and status buttons and then just the status button until port 2 blinks.

The push-button method is very technical and should be used only if all else fails. By hooking a dumb terminal or a PC with a communications to port 0, you can use the MS-10SP's built-in menu program to change speeds, time-outs, and other parameters. The menus are simple but effective and they include selections for listing jobs still queued, dumping port assignments, and printing an analysis of usage by port.

The configuration software that comes with the MS-10SP is by far the easiest way to set up the system. Before you start, you execute one batch that prints out detailed installation instructions and another that copies the configuration software to the hard disk. You identify the type of unit, its logical name, and communications parameters. You can select from over 40 device types, such as HP LASERJET, and group devices with a common name so that one prints if the other is busy. Once you identify the port characteristics, the installation program downloads them to the MS-10SP and resets the unit to the new settings.

After you install the port information, the batch file configures BIGPOP, the memory-resident pop-up utility that helps you control the printer sharing on each PC. You can change the hotkey definition used to call up BIGPOP and set up a port as transparent, in which no commands are recognized, or nontransparent, in which cancel codes and port modification characters are intercepted and executed. The batch file will then load BIGPOP and add it to your AUTOEXEC file if you wish.

The MS-10SP supports a wealth of functions, and each port has a unique setting for all of them. The ports can have both hardware and software handshaking, and each can have a unique character sequence that will be sent at the end of each job. You can set the time-out period from 0 seconds to 255 minutes and have a top-of-page sent after each job if the last character received is not a form feed. You can specify a character to cancel a job, force a time-out, pause for paper changes, or enter a command mode. You send characters at the beginning of a job and set up the default printer port for each input port.

You activate BIGPOP from within any application with Ctrl-F6 and it shows you the printers that are available for your use. From the list, you select a printer and send various predefined escape codes that change fonts on it. You can also specify multiple copies and select soft fonts that

Zillions ready to zip to

☐ **3½" format available from us. Specify when ordering.**
◙ **package includes both 5¼" and 3½" disks.**
Ⓡ **3½" format available from manufacturer by request. Call us for details.**
CP—copy-protected, **NCP**—not copy-protected

SOFTWARE

We only carry the latest versions of products. Version numbers in our ads are current at press time.

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☐Advanced Keyworks 1.0 ..... 175.
☐Alpha/three 1.1 *(dB3 file compatible)* ..... 219.
American Small Business Computers
☐Design CAD 3.0 *(NCP)* ..... 169.
Application Techniques ... NCP
ⓇPizazz 2.0 *(see what your printer is missing)* 45.
Ashton-Tate ... NCP
◙dBase III Plus 1.1 *(the standard)* ..... call
◙Framework II 1.1 ..... call
◙MultiMate Advantage II 1.0 ..... 299.
ATI ... NCP
☐How to use DOS, BASIC ..... *each* 33.
☐How to use Lotus, dBase III Plus. ..... *each* 43.
Best Programs ... NCP
ⓇPC/TexCut *(for 1987 taxes)* ..... 45.
Bible Research ... NCP
☐THE WORD 4.0 *(specify KJV or NIV)* ..... 159.
Borland International ... NCP
☐Sidekick 1.5 ..... 57.
☐Turbo BASIC 1.0 ..... 67.
☐Turbo C 1.0 ..... 67.
☐Turbo Pascal 4.0 ..... 67.
☐Superkey 1.1 ..... 67.
☐Turbo Lightning 1.0 *(speller, thesaurus)* ... 67.
☐Reflex Workshop ..... 67.
☐Reflex 1.1 ..... 99.
☐Eureka 1.0 ..... 109.
☐Quattro 1.0 ..... 129.
◙Paradox 2.0 *(easy-to-use database)* ..... 419.
Breakthrough ... NCP
☐Timeline 2.0 *(project management)* ..... 289.
Broderbund ... CP
ⓇPrint Shop *(banners, signs, etc.)* ..... 35.
ⓇPrint Shop Companion *(tools for Print Shop)* 33.
Chipsoft ... NCP
☐TurboTax Personal/1040 5.0 ..... 45.
☐Tally Ho 1.01 *(financial calculator)* ..... 32.
Computer Associates ... NCP
◙SuperCalc 4 1.1 ..... 299.
Core International ... NCP
☐Corefast 1.3 ..... 109.
Crosstalk Communications ... NCP
☐Crosstalk XVI 3.61 ..... 95.
☐Crosstalk MK.4 1.0 ..... 129.
Dac Software ... NCP
☐Dac Easy Base 1.0 ..... 32.
☐Dac Easy Payroll 2.0 ..... 45.

PC Connection Software Special
through January 31, 1988

North Edge Software ... NCP
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Are you tired of using little slips of paper to keep track of time spent on client's projects? Timeslips will relieve you of that drudgery by letting your computer do the work.

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☐Gem Desktop Publisher 1.0 ..... 259.
Executive Systems ... NCP
☐XTREE 2.0 *(DOS shell)* ..... 45.
☐XTREE Pro 1.0 ..... 69.
☐Hot 4.0 ..... 95.
5th Generation ... NCP
☐Fastback 5.14 *(hard disk backup)* ..... 89.
☐Fastback Plus 1.01 ..... 99.
Funk Software ... NCP
☐Sideways 3.2 ..... 42.
☐Noteworthy 1.0 ..... 49.
☐Inword 1.0 ..... 59.
Generic Software ... NCP
☐Generic CADD 3.0 ..... 69.
☐Dot Plot ..... 35.
☐Auto Dimensioning ..... 35.
☐Auto Conversion ..... 35.
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Harvard Associates ... NCP
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Hayes ... NCP
☐Smartcom II 3.0 ..... 89.
Headlands ... NCP
☐PC TALK4 1.3 ..... 55.
Hilgraeve Software ... NCP
☐HyperACCESS 3.2 ..... 89.
Individual Software ... NCP
☐The Instructor II ..... 26.
◙Directory Assistance 1.0 ..... 33.
☐Professor DOS *(with Smartguide)* ..... 33.
☐Smartguide *(mem. resident DOS reference)* 15.
☐Typing Instructor II ..... 26.
Intersecting Concepts ... NCP
☐Display Master 2.11 *(for EGA systems)* .... 39.

Javelin Software ... NCP
☐Javelin Plus 2.01 ..... $159.
Lifetree ... NCP
☐Volkswriter Deluxe Plus 1.0 ..... 69.
☐Volkswriter 3 1.0 ..... 147.
Micro Education (MECA) ... CP
☐Managing Your Money 4.0 ..... 129.
MicroPro ... NCP
☐WordStar Professional Release 4.0 ..... 229.
☐WordStar 2000 Plus Release 3 ..... 229.
Microrim ... NCP
☐R:base System V 1.1 ..... 429.
☐dB Graphics 1.0 ..... 199.
Microsoft ... NCP
☐Learning DOS *(for any version)* ..... 33.
☐Windows 2.02 ..... 65.
◙Works 1.0 ..... 119.
Bookshelf 1.0 *(CD-ROM)* ..... 189.
Bookshelf 1.0 w/Amdek Laser Drive .... 799.
◙Word 4.0 ..... 239.
◙Chart 3.0 ..... 249.
◙Excel 1.0 *(requires 80286/80386 CPU)* .. 319.
LANGUAGES
☐Quick BASIC 4.0 ..... 59.
☐Quick C 1.0 ..... 65.
ⓇMacro Assembler 5.0 ..... 97.
ⓇC Compiler 5.0 ..... 279.
ⓇFORTRAN Compiler 4.01 ..... 289.
Migent ... NCP
◙Ability Plus 1.0 ..... 149.
Monogram ... NCP
☐Dollers & Sense 3.0 ..... 105.
Nantucket Software ... NCP
☐Clipper *(Autumn '86, dB3 Plus compiler)* 399.
New England Software ... NCP
☐Graph-in-the-Box Release 2 ..... 57.
Nolo Press ... NCP
ⓇWillMeker 1.0 ..... 35.
North Edge Software ... NCP
☐Timeslips III 3.2 ..... special
Paperback Software ... NCP
☐VP-Planner 1.37 *(1-2-3 vers. 1A compat.)*.. 57.
☐VP-Planner Plus 2.0 ..... 95.
☐VP-Info 1.4 ..... 65.
☐VP-Expert 1.2 *(expert system)* ..... 65.
☐VP-Graphics 1.0 ..... 65.
Paul Mace ... NCP
☐H/Test-H/Formet 2.0 *(hard-disk tools)* ..... 49.
☐Mace Utilities 4.1 *(DOS utilities)* ..... 59.
Personics ... NCP
ⓇSmartNotes 2.0 *(Post-It-like notes)* ..... 49.
ⓇSeeMORE 1.0 ..... 49.
Ⓡ@BASE 1.0 ..... 119.
Quarterdeck ... NCP
☐DESQView 2.01 *(operating environment)* .. 79.
☐Expended Memory Menager 4.0 ..... 39.
Simon & Schuster ... NCP
Typing Tutor IV ..... 33.
Webster's New World Writer 1.04 ..... 59.
Softlogic Solutions ... NCP
Software Carousel 2.0 *(everything resident)* 35.
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Software Publishing ... NCP
- ■ PFS:First Publisher 1.0 ... $59.
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- ◉ PFS:First Choice 2.0 ... 89
- ◉ PFS:Professional Write 1.03 ... 119.
- ◉ PFS:Professional File 1.01 ... 149.
- ◉ Harvard Graphics 2.0 ... 239

Springboard ... NCP
- Newsroom•Pro ... 45.

Symantec ... NCP
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- ◉ Q & A Write 1.0 ... 119

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- ■ True BASIC Libraries ... *each* 32.

Turner Hall ... NCP
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- Computer SAT ... 35.

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- □ Ticket to London, Paris, or Spain ... *each* 25.
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- My Letters,Numbers,Words *(ages 2 to 6)* ... 27
- Kids Stuff *(eges 2 to 6)* ... 27.

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- ■ Calculus ... 32.

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- Mean 18 *(greet golf game, CGA or EGA)* ... 29.

Electronic Arts ... CP *(reqs. graphics brd.)*
- Patton vs Rommel ... 32.
- Starflight *(NCP)* ... 32
- Chessmaster 2000 ... 32.
- Chuck Yeager's Flight Simulator ... 32.
- Grand Slam Bridge ... 45.

Hayden Software ... CP
- Sargon III ... 15.

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Microleague Sports ... CP
- Microleague Baseball *(requires CGA)* ... 25.

Microprose ... CP
- F-15 Snike Eagle *(requires CGA)* ... 22.
- Silent Service *(requires CGA)* ... 22.
- Gunship *(requires CGA or EGA)* ... 32.

Microsoft ... CP
- □ Flight Simulator 2.13 *(reqs. graphics brd.)* ... 32.

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- Falcon *(F-16 simulation, requires CGA)* ... 32.

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- Jet *(requires EGA or CGA)* ... 33.

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HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods

AST Research ... 2 years
- I/O Mini 2 C/S/P ... $89
- SixPakPlus 64k C/S/P *(now upgrades to 576k)* ... 129.
- SixPakPremium 256k C/S/P *(upgrades to 1 Meg or 2 Meg w/Piggyback)* 199.
- Advantage Premium 512k S/P *(upgrades to 1 Meg or 2 Meg w/Piggyback)* 299.
- RAMpage! 286 512k *(upgrades to 2 Meg)* 339.
- RAMpage/2 64k *(upgrades to 2 Meg)* ... 209.
- Hot Shot 286 *(10 MHz)* ... 379.

AST Premium series boards and RAMpage! boards support EMS and fully support EEMS.

Amdek ... 1 year
- LaserDrive-1 *(CD-ROM Drive; 90-day wrty.)* 629.
- Video 310A *(amber monochrome monitor)* 139.
- Video 410A *(amber monochrome monitor)* 159.

Compucable ... 2 years
- 2-Position switch box ... 29.
- 3-Position switch box ... 39.

Cuesta ... 1 year
- Datasaver 200 Watt *(PC backup power unit)* 339.
- Datasaver 400 Watt *(AT backup power unit)* 459.

Curtis ... lifetime
ACCESSORIES
- Disk Holder DB-1 *(holds 50 5¼" disks)* ... 8.
- Printer Stand PS-1 ... 18.
- Universal System Stand SS-3 ... 25.

CABLES
- Smartmodem-to-PC Cable *(9 feet)* ... 17.
- Printer-to-IBM cable *(9 feet)* ... 17.

SURGE SUPPRESSORS
- Safestrip SP-3 *(6 outlets; 1 year wrty.)* ... 21.
- Diamond SP-1 *(6 outlets)* ... 32.
- Ruby *(6 outlets; EMI/RFI filtered; 6 ft cord)* ... 59.
- Ruby-Plus *(w/FAX & modem protection)* ... 69.

DCA ... 1 year
- Irma 2 *(3270 emulation board)* ... 729.
- Irma PS/2 *(for Models 50 and 60)* ... 729.

Epson ... 1 year
All cps speeds listed are for 12 cpi mode
- EX-800 printer *(80 column, 300 cps)* ... call
- EX-1000 printer *(136 column, 300 cps)* ... call
- FX-86e printer *(80 column, 240 cps)* ... call
- FX-286e *(136 column, 240 cps)* ... call
- LQ-850 printer *(80 column, 264 cps)* ... call
- LQ-1050 printer *(136 column, 264 cps)* ... call
- LQ-2500 printer *(136 column, 324 cps)* ... call
- LX-800 printer *(80 column, 180 cps)* ... call
- *Printer-to-IBM cable (6 feet)* ... 15.

5th Generation ... 6 months
- Logical Connection 256k ... 319.
- Logical Connection 512k ... 379.

Hayes ... 2 years
- Smartmodem 1200 ... 299.
- Smartmodem 1200B *(with Smartcom II)* ... 299.

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Hercules Graphics Card Plus . . . . . 189.
Hercules Incolor Card *(includes RAMfont)* . . call

IMSI ... lifetime
Optimouse *(includes Dr. Halo II)* . . . . . 99.

Intel ... 5 years
Inboard 386 *(for AT, req. installation kit)* . . . . 949.
Inboard Installation Kit *(specify computer)* . . 139.
Aboveboard 286 512k. . . . . 319.
Aboveboard PS/286 512k S/P. . . . . 349.
8087 *(for IBM-PC & XT)* . . . . . 114.
80287 *(for IBM-PC AT & XT 286)* . . . . . 195.
80287-8 *(for 8 MHz 80286 machines)* . . . . . 249.
80387 *(16 MHz)*. . . . . 499.

Kensington Microware ... 1 year
Printer Muffler *(80 column)* . . . . . 39.
Masterpiece . . . . . 94.
Masterpiece Plus. . . . . 109.
Masterpiece Remote . . . . . 119.

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101 Keyboard *(enhanced layout)* . . . . . 99.

Kraft ... 1 year
Three-button Joystick . . . . . 33.

Microsoft ... 1 year
Mouse with Paintbrush *(specify bus or serial)* . 99.
Mouse with Easy CAD *(specify bus or serial)* . 119.

Migent ... 1 year
Pocket Modem *(ext., 1200 baud, w/Bitcom)* 169.

MSC Technologies ... lifetime
Formerly Mouse Systems Corp.
PC Mouse w/PC Paint Plus *(serial version)* . . 99.
PC Mouse w/PC Paint Plus *(bus version)* . . 109.

NEC ... 2 years
GB-1 *(supports 640 x 480 resolution)* . . . . . 279.
Multisync II *(800 x 560 max. res.)* . . . . . 547.
Multisync Plus *(968 x 750 max. res.)* . . . . . 949.

NSI Logic ... 3 years
Epic 480 *(extended EGA)* . . . . . 129.
Smart EGA Plus *(supports 800x600 res.)* . . 269.

Okidata ... 1 year
Laserline 6. . . . . call
Laserline 6 RAM cartridge *(384k)* . . . . . 239.
Personality Module *(specify ser. or par.)*. . . . 159.
Toner Cartridge . . . . . 23.

Orchid Technologies ... 2 years
Tiny Turbo 286 . . . . . 289.
PC Turbo 286e w/1 Meg *(10 MHz)* . . . . . 729.
Jet 386 *(includes cable kit)*. . . . . 869.
RAMquest 2 Meg *(for PS/2 models 50/60)* 699.

Practical Peripherals ... 5 years
Microbuffer Mini *(parallel print buffer w/128k)* 79.
Microbuffer Inline *(par. print buffer w/256k)* 149.
1200 Baud Internal Modem *(w/ProComm)* . . 89.
1200 Baud External Modem *(w/ProComm)* 109.
2400 Baud Internal Modem *(w/ProComm)* 159.
2400 Baud External Modem *(w/ProComm)* 189.

Princeton Grsphics ... 1 year
MAX-12E *(amber monochrome monitor)*. . 139.
HX-12E *(640 x 360 max. res.)* . . . . . 499.

Quadrsm ... 2 years
ProSync *(with mouse; supports 640x480 & 752x410 resolution)* . . . . . $259.
Microfazer II Print Buffer 64k . . . . . 249.

Sony ... 90 days
Multiscan Monitor *(900 x 560 max. res.)* . . . . call

Toshiba ... 1 year
P321SL printer *(80 col., 216 cps, w/tractor)* 529.
T1000 Laptop *(80C88, 6.4 lbs., 5 hr. battery)* call
T3100/20 Laptop *(80286, 8 MHz, 20 Meg)* . . call

Tseng Labs ... 1 year
EVA 480 *(supports 640x480 resolution)* . . . 299.

Video 7 ... 2 years
VEGA Deluxe *(supports 640x480)* . . . . . 259.
VEGA VGA *(supports full VGA specs)* . . . . . 329.

DRIVES

IOMEGA ... 1 year
Bernoulli Box 20 Meg w/PC2 card. . . . . 1649.
10 Meg cartridge . . . . . 59.
Bernoulli Box 40 Meg w/PC2 card. . . . . 1849.
20 Meg cartridge . . . . . 82.

Miniscribe Corp. ... 1 year
ScribeCard 30 Meg *(68 ms)*. . . . . 479.

Mountain Computer ... 1 year
40 Meg Internal Tape Drive *(XT or AT)*. . . . . 379.
40 Meg External Tape Drive *(XT or AT)* . . . . 499.
40 Meg External Tape Drive w/Power Supply *(XT or AT)* . . . . . 569.
DriveCard 20 Meg *(80 ms)* . . . . . 479.
DriveCard 30 Meg *(78 ms)* . . . . . 569.
DriveCard 50 Meg *(54 ms)* . . . . . 699.

Plus Development ... 2 years
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PC, XT 720k Drive *(3½" half-height)* . . . . . 109.

Toshiba ... 1 year
PC, XT 360k Drive *(5¼" half-height)*. . . . . 99.
AT 360k Drive *(5¼" half-height)* . . . . . 117.

MEMORY

64k Upgrade Set *(150 ns, set of 9)* . . . . . call
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256k Upgrade Set *(120 ns, set of 9)* . . . . . call

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All disks have a lifetime warranty.

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Maxell MD2-DM *(10 disks per box)*. . . . . 13.
Verbatim Datalife *(10 disks per box)* . . . . . 13.

5¼" DS/High Density Disks for AT *(1.2 Meg)*
Fuji MD2HD *(10 disks per box)* . . . . . 22.
Sony *(10 disks per box)* . . . . . 23.
Maxell MD2-HDM *(10 disks per box)* . . . . . 23.
Verbatim Detelife *(10 disks per box)* . . . . . 22.

3½" DS/DD Diskettes *(720k)*
Sony *(10 disks per box)* . . . . . 18.
Maxell *(10 disks per box)* . . . . . 20.

3½" DS/High-Density Diskettes *(1.44 Meg)*
Fuji *(10 disks per box)* 55
Maxell *(10 disks per box)* . . . . . 59.

MISCELLANEOUS

CompuServe
CompuServe Information Service . . . . . 24.
Grolier's OnLine Encyclopedie . . . . . 32.

Cables ... lifetime
Smartmodem-to-AT cable *(9 feet)* 19
Parallel Printer cable *(15 feet)*. . . . . 19.

PC Connection Computer Toolkit . . . . . 22.

OUR POLICY

- We accept VISA and MASTERCARD.
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- COD max. $1000. Cash, cashier's check, or money order.
- 120 day limited warranty on all products.*
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Note: Accounts on net terms pay actual shipping.

Continental US:
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- For monitors, printers, hard drives, and computers, actual UPS Blue charge will be added. For all other items, add $2 per order.

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For the IBM-PC (XT & AT) *Exclusively*

PC CONNECTION®

PC Paradise 5.

Blast from the past.

It was five years ago that we and our furry figurehead first entered the fledgling PC mail order market. At the time, Marlow, NH (pop. 550) wasn't exactly *au courant*. When we said we needed an 800 number, the locals suggested 853. Of course, we were all beginners then. Our typical customer was trying to figure out if he really needed a full 256k of RAM.

Hey buddy, can you spare a paradigm?

Over the years, as our mighty mascots romped across these pages in various uncompromising positions, our customers started using much more powerful software and peripherals. Now, megabytes of memory, mountains of storage, glittering graphics, and professional printouts are available to all.

Marlow, too, has changed. We've rebuilt the dam outside our clapboard headquarters, and transformed the old Inn into a showroom and training center. But the occasional horse can still be seen strolling down the main drag, chickens still pick pecking orders in the parking lot, and the Blueberry Festival is still the highlight of the year.

We haven't, however, changed our terribly old-fashioned way of doing business. We still think that you, our customers, deserve only the latest versions of products, toll-free technical support, full information on price and availability, and exceptionally fast service.

A T-shirt in December?
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you define in the installation process. Another menu helps you cancel and end jobs prematurely, while a third menu will send predefined codes from files that you have created. An escape will clear BIGPOP from your screen.

Once the MS-10SP has been configured, it is effortless to use. It can receive jobs simultaneously from all ports and it will send the jobs to the printer on a first-come, first-served basis. The port status lights will glow to show activity on input and output ports and will blink if the job is buffered. The time-out functions will switch the buffer from job to job automatically, and the form-feed function clears each job out of the printer.

The MS-10SP manual is massive and a little intimidating. However, once you start reading it you'll find over 150 pages of valuable instructions and other information. The installation section has many pictures and detailed steps to help you install the MS-10SP and the BIGPOP software. The operations section covers all the functions well, and it includes detailed listings and examples of setup strings for most of the popular printers. The utilities section describes the more advanced features, and the appendixes discuss cabling needs, built-in functions, and factory settings. There is also a complete glossary of terms at the end.

There are only some minor problems with the MS-10SP. You must run BIGPOP before other resident software like *SideKick* or it will hang up the system. Some of the features are quite advanced, and the unit may be too much for a novice user to handle. The manual often mixes examples and discussions of two or three PrintDirector models in the same section, and it is easy to get confused about a feature you may not even have.

Overall, the MS-10SP is a powerhouse. It's difficult to find anything else on the market with so many features. It gives you full control of every input and output port, and the pop-up menu makes it a snap to change printers and fonts. If you can afford the $1,395 price tag, take a real close look at this one.

PRINTDIRECTOR JR. To meet the need for low-cost printer sharers, Digital Products has borrowed from its PrintDirector series to create the PrintDirector Jr., a device that shares one printer with up to five PCs. The PD Jr. comes with six female DB-25 connectors, five for serial input and one for serial output. The box is small, measuring about 3 by 10¾ by 6¾ inches, and it is powered by a 35-watt transformer attached to the back of the unit next to the ports. On the front of the PD Jr. are six status lights, one for each port, and a reset button with its own indicator.

The PD Jr. is completely configured at the factory with 256K of buffer memory, expandable to 512K. Each port is fixed at 9,600 bps and the time-out period is fixed at 20 seconds. The device will eject the last page of a print job automatically unless the last character in the job is a form feed, and it supports both hardware and software protocols. The PD Jr. can be factory upgraded to the PrintDirector 6, a more sophisticated sharer sold by Digital Products, and multiple PD Jr.'s can be chained together for sharing more than five ports.

You connect the device to your PC with a female-to-male, straight-through cable. The printer is also hooked up with a straight-through cable, usually male-to-male with DB-25 connectors. Since there are no configuration capabilities, you are ready to use the PD Jr. as soon as you hook up the cables. A status light will glow steadily whenever there is activity on a port. If the output port is busy, the light will start blinking when the job has timed-out after 20 seconds. You can cancel all of the jobs that are still in the buffer by pushing the reset button on the front of the unit. To cancel only those jobs sent by a single PC, you can send a string that includes 40 plus signs, an exclamation point, a Ctrl-X, and two Ctrl-T's followed by a G. The manual is quite thorough, even though there aren't many features to discuss. It covers every detail of the installation well, and the features of the unit are described in an understandable way. There is a special section on setup codes for most of the popular printers and an appendix that explains cabling requirements and wiring considerations.

The PD Jr. was built with features for the average user who has simple printer-sharing needs. There are no commands to worry about and no hardware or software configurations to set, so just about anybody can hook it up and use it immediately. You lose some of the flexibility found in other devices, but you may not need to pay for it either. If you want an effortless printer sharer with a few handy features, the PD Jr. may be a good one to check out.

EXTENDED SYSTEMS INC.

ShareSpool ESI-2001 for the LaserJet ShareSpool ESI-2076

The ShareSpool printer sharers were the first products offered by Extended Systems, a 3-year old company that specializes in sharing devices. One of its new announcements, the ESI-2001, is a circuit board for the HP LaserJet series II that provides three serial inputs to the laser. Another new product, the ESI-2076, is a desktop printer sharer with seven serial inputs and one output port to a serial device.

The ESI-2001 is a small board that fits into the I/O slot on the side of the HP LaserJet Series II. Three RJ-45 receptacles are mounted on the board for inputs from serial devices, and a male DB-25 connector runs from the board to the back of the LaserJet. You connect your PC to the device with eight-wire, straight-through cables with RJ-45 connectors running from the ESI-2001 to a female DB-25 connector on your PC with a RJ-45 receptacle wired for DCE. The cables and connectors are

PC MAGAZINE FACT FILE

ShareSpool ESI-2001 for the LaserJet
ShareSpool ESI-2076
Extended Systems Inc.
6062 Morris Hill Ln.
Boise, ID 83711
(208) 322-7163
List Price: ESI-2001, $495, ESI-2076, with 256K, $995; with 512K, $1,095.
Requires: ESI-2001: HP LaserJet Series II with available I/O port. ESI-2076: Serial port
In Short: Two capable printer sharers with the basic features expected in a sharing device.

CIRCLE 693 ON READER SERVICE CARD

Extended Systems offers the ShareSpool ESI-2001, a board that lets PCs share HP LaserJet Series II printers, and the ShareSpool ESI-2076, a desktop printer sharer with eight ports.

available from ESI, and the part numbers are clearly laid out in the documentation.

The ESI-2076 is a compact device, sitting only 3 inches tall, with seven RJ-45 serial input receptacles, one DB-25 connector for output to the serial printer, and a connector for a 60-watt power supply. On the front of the sturdy aluminum casing is a button for aborting jobs and a status light showing the results of the start-up self-test. You use the same cables mentioned above to connect your PC to the sharer, and you use a special male-to-male reversing cable from the sharer to the printer.

The baud rates for both devices are set on the sharer circuit board. The ESI-2001 uses jumpers to select 9,600 or 19,200 bps, three jumpers for each port and one for the cable to the laser. To set the ESI-2076, you must open the front of the box with a screwdriver and set the DIP switches for each port to a setting from 300 to 9,600 bps. You can also force a page eject at the end of each job on the same switches. The factory settings are 9,600 for all ports and no page eject.

Both devices use the same five software commands to modify the internal settings. These commands start with the three-character sequence ".,:", and you can send them from your word processor or with a DOS COPY command. The end-of-job time-out command, which disconnects a port after a period of 1 to 255 seconds of inactivity, and the reset command, which sends a string to the printer after each job, affect every job sent to the device. The other three commands for sending multiple high- or low-priority copies and disabling the commands affect only the current job.

The ESI-2001 and ESI-2076 both come with a 256K printer buffer. The ESI-2076 is upgradable to 512KB. The devices will accept and buffer transmissions from each port simultaneously and jobs will be printed on a first-come, first-served basis. In addition, the output port on the ESI-2076 can be connected to the input port on another ESI-2076, increasing the number of PCs that can share the same printer.

The documentation is straightforward and complete. It describes the device's ca-

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pabilities and leads you logically through the setup of hardware jumpers and DIP switches. The manual explains the commands completely and provides good examples. An appendix describes pinouts and connector requirements.

The ESI-2001 and ESI-2076 are simple devices with few frills. Many printer sharers have status lights to indicate activity on the port, yet the ESI-2076 has only one. Although generous, the 512K buffer may be inadequate for printers with heavy traffic from minicomputers or seven active PCs. Overall, however, the ShareSpool devices cover most of the basics expected in a printer sharer.

Fifth Generation's Logical Connection is configured through two utility programs provided with the device and can connect up to 45 printers, computers, and modems in a variety of ways.

FIFTH GENERATION SYSTEMS

Logical Connection

Fifth Generation Systems, maker of the popular backup program *Fastback*, has created the Logical Connection, a device that connects printers, computers, and modems to each other in a variety of ways. An unobtrusive device measuring 14 inches wide, 5 inches deep, and only 1 inch tall, the Logical Connection is made up of four serial ports, two parallel input ports, and two parallel output ports, all using DB-25 connectors. You can also daisychain up to 45 devices with simple twisted-pair cable connected to port 0, a high-speed, RS-485 serial port.

The Logical Connection's case is made of sturdy yet lightweight metal, and it comes with a 25-watt power supply and a cable to connect one PC serial port to the device. To connect devices going into the switch, you will need standard null modem cables, female-to-female from the serial ports and male-to-female from the parallel ports. You can use the same cables without the switch to hook up cables running from the device to the peripheral.

The Logical Connection is configured entirely through software control using two utility programs provided with the device, LCSETUP and POPLC. Using your PC as the input device, LCSETUP communicates with the Logical Connection through one of your serial ports to port 0 on the device. The program uses simple menus to lead you through the setup and is a pleasure to run. It shows a descriptive picture of the device on the screen, and by hitting Ctrl-M you can call up a menu to change the attributes of the port you have selected.

Each port can be configured to send a form feed to the peripheral each time the device switches jobs. In addition, to ensure that the Logical Connection will disconnect and move on to another job when there is no activity, you can specify a timeout period of 0 to 255 seconds for each input port. For each serial port, you can also specify the communications parameters and the handshaking protocol (hardware, XON/XOFF, or both). All of the devices can be given logical names, such as JOE'S PC and SAM'S LASER, and setups can be saved on the disk for recall later.

LCSETUP also gives you an easy way to define the relationships between all the different devices you're hooking up. Once you set up the name and port settings, you can enter up to seven connections that can be made to and from the device you have selected. The first selection is the default connection, and each port can be defined as switchable from one port to another or fixed to send only to a specific port.

Although you've defined the connections, you still haven't sent them to the Logical Connection. To do so, you must select a menu choice, press a reset button recessed into the side of the box, and hit Return within 10 seconds of resetting the device. The RUN and STATUS lights will light up, indicating that the configuration is being changed and stored in a ROM chip on the Logical Connection.

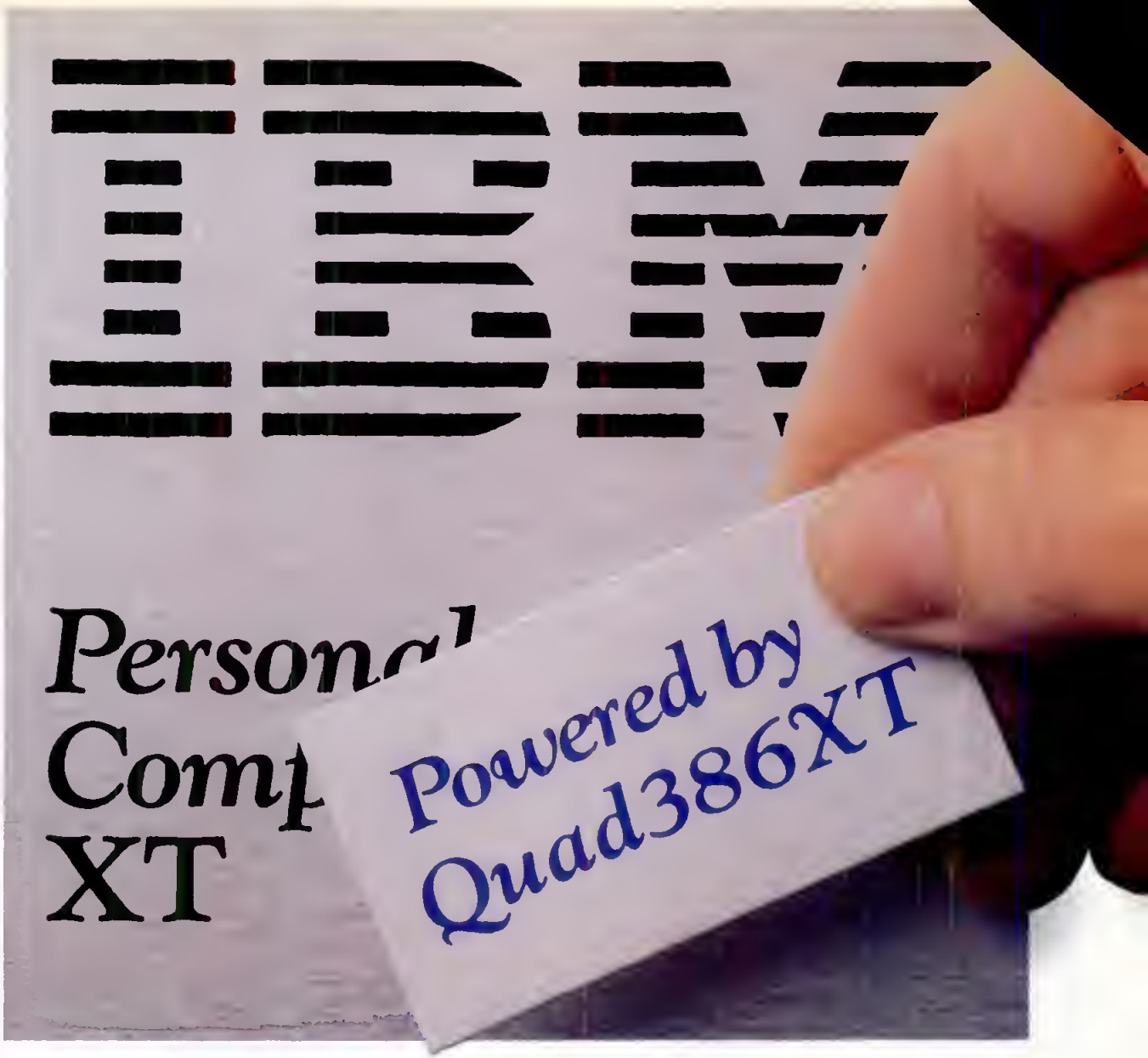
You can temporarily change the configuration with POPLC, a memory-resident utility run on each PC sharing the device.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Logical Connection
Fifth Generation Systems
2691 Richter Ave., #107
Irvine, CA 92714
(800) 225-2775
(714) 553-0111
List Price: With 256K buffer, $495; with 256K buffer, $595.
Requires: Serial port for configuring ports.
In Short: A compact, well-documented device sharer with four serial ports, four parallel ports (two in, two out), and flexible, on-line reconfiguration capabilities.

CIRCLE 692 ON READER SERVICE CARD



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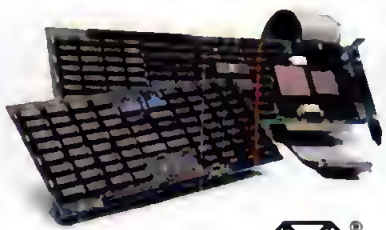

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CIRCLE 181 ON READER SERVICE CARD

To make a change, you hit Alt-L and a window pops up in the middle of your application, where you can select another printer or any device hooked up to the Logical Connection. You can also change port assignments, speeds, and other parameters entered in LCSETUP and hit Esc to remove the window.

The Logical Connection automatically converts serial to parallel when it is called for in the configuration. In addition, you can connect multiple Logical Connection units with twisted-pair wire or a modem, allowing all devices to share all the peripherals. You can also establish computer-to-computer connections for transmitting data between PCs, using popular communications packages such as *Crosstalk* or *ProComm*.

The manual provided with the Logical Connection is well laid out and orderly. It describes not only the method for making connections but also some of the theory behind them. The explanations for setup and hookup are straightforward and easy to follow, making it easy for even the novice to set up the device.

■ The manual provided with the Logical Connection is well laid out and orderly.

There is very little to complain about in the Logical Connection. You are limited to a 512K internal buffer, an amount quickly used up if many PCs are hooked to a single printer. The procedure requiring you to press a reset button before you send the configuration information was a bit clumsy. Although some of the more advanced features can be a little confusing to set up, the manual helps you solve most of your problems quickly.

The Logical Connection is a flexible device sharer that offers good user interface and expandability in a compact box. It's easy to install and use, and it can grow into quite a little network of shared devices. It's well worth checking out.

GILTRONIX INC.

Giltronix EZ Queue 3326

The EZ Queue 3000 series, from Giltronix, is a group of switching devices that redirect serial inputs to both serial and parallel output ports. The 3326 is the biggest of the bunch with 24 serial input/output ports and two parallel output ports. On the back of the hefty metal case are four rows of six male DB-25 serial connectors and another row of two female DB-25 parallel connectors. The front panel is rather stark, with only a power light, a fault indicator, and a setup light.

The 3326 comes with a built-in power supply, a 2MB buffer, and a cable to hook a PC serial port to port A on the device. The unit is large, measuring 19½ inches wide by 11¾ inches deep and standing 4 inches tall. Female-to-female cables must be used from the PC to the 3326, but no specific pin combinations are required. When you first set up the device, you push a reset button that instructs the 3326 to examine each active device to determine if it is DCE or DTE. It then saves the information and automatically adjusts its signals to transmit and receive properly. Cables from the unit must always be female-to-male for serial printers and male-to-Centronics for parallel printers.

Port settings are sent from a PC or dumb terminal tied to port A on the 3326. Giltronix supplies a simple communications program that can send changes to the unit and receive configuration information. Every port has its own settings for the baud rate and parity, time-out period, handshaking protocol, automatic header, end-of-job form feed, and default printer

PC MAGAZINE FACT FILE

Giltronix EZ Queue 3326
Giltronix Inc.
3780 Fabian Way
Palo Alto, CA 94303
(800) 531-1300
(415) 493-1300
List Price: With 256K, $2,345; with 512K, $2,470; with 1MB, $2,720; with 2MB, $3,220.
Requires: Serial port.
In Short: A monster printer sharer with lots of features and flexibility.

CIRCLE **691** ON READER SERVICE CARD

With 24 serial input/output ports and two parallel output ports, the Giltronix EZ Queue 3326 is the biggest product in the EZ Queue 3000 series. It has a built-in power supply and 2MB of RAM.

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- Basic unit expandable to 24 ports by 4-port modules offered in serial/parallel combinations.
- Standard 512KB buffer expandable to 4½ megabytes, to handle big print/plot jobs and many small ones.
- Buffer memory dynamically allocated to maximize buffer utilization.
- Simultaneous data input and output on *all* ports, so no devices are kept waiting.
- Computer-to-computer communication concurrent with all other operations.
- Full duplex communication allows file transfer capability with many communications software packages.
- Compatible with virtually all computers, printers, plotters, modems and other peripherals.
- Pop-up RAM resident PC support software allows peripheral selection via hot key.
- Super fast throughput allows data to pass through with no apparent processing delays.
- Many user-definable parameters including separate baud rates, flow control and parity for each port.
- Internal serial-to-parallel and parallel-to-serial conversion.
- Cascading capability to increase available number of ports.
- Unlimited hotline tech support.
- Designed and manufactured in the U.S.A.

BayTech

Bay Technical Associates, Inc., Data Communications Products Division
200 N. Second St., Bay Saint Louis, MS 39520 USA
Telex 910-333-1618 BAYTECH, Telephone 601-467-8231 or toll-free

800-523-2702

CIRCLE 214 ON READER SERVICE CARD

for output. These parameters are sent to the 3326 separated by commas and preceded by the port type (P for parallel, S for serial), the port ID (A-X, 1 and 2), and a colon. Parameters that don't change can be left out as long as the proper number of commas is used.

The 3326 can operate at bps rates of 110 to 9,600 and use a time-out period of 1 to 999 seconds. It can accept both hardware and software handshaking and send a form feed automatically at the end of a job. Each port must be assigned as an input device and assigned a default output port, or as an output port with its own queue number. It can also send a header page that shows the name of the port that sent the request. To increase flexibility, the 3326 requires both the input and output ports to have the same header and form-feed code before it will perform the function.

The 3326 accepts transmissions simultaneously from all ports, and the data is buffered until the requested printer is ready. One of the most powerful features of the 3326 is the method it uses to assign a printer. Each printer is given an ID, and each input port must establish a default output port. If more than one printer is assigned the same ID, the device will look for the first available one and send the printout to it. You can use your word processor, DOS, or a memory-resident pop-up utility to switch to a different printer by sending a three-character sequence, "<>?", followed by the printer ID. Once the job is complete, the 3326 will reset the port's destination to the original output port unless you ask for a permanent lock on the port in your sequence. You can also customize the pop-up utility program to give each output port a logical name and a unique printer selection command.

The documentation leads you methodically through setup and installation of the 3326. There is also a useful setup form that helps you assign names and settings to each of your input and output ports. The manual discusses the features of the unit clearly, and important points are highlighted throughout.

The EZ Queue 3326 is a flexible printer sharer with all the capabilities you could want in such a device. Twenty-four ports may be overkill, but the box is available with as few as six ports with the same features. If you've got lots of computers, lots of printers, and a hunger to control them all easily, try the Giltronix on for size.

INTEGRATED MARKETING CORP.

Data Manager Data Net 1551

The Data Manager Data Net 1551 is a printer buffer and device sharer offered by Integrated Marketing Corp. Only 2 inches tall and about 14 inches square, the Data Manager has six serial ports on the back of the unit that can act as either input or output devices. On the front is a switch to reset the buffer, a red error light, and a green ready light.

The unit comes with a built-in power supply, and you set up the hardware configuration with DIP switches inside the box. The Data Manager is configured with 256K of buffer memory that can be expanded to 1MB. Each port can use as much memory as it needs, and the memory is reallocated to the pool once the print request is complete. You connect your PC to the Data Manager with a female-to-male, null-modem cable with a DB-25 connector. You connect output devices such as printers, plotters, or modems to the unit with a male-to-male cable using DB-25 connectors.

The Data Manager is shipped with five ports configured as 9,600-bps input devices and one port set for 9,600-bps output. You can set each port differently as in-

FACT FILE

Data Manager Data Net 1551
Integrated Marketing Corp.
1031-H E. Duane Ave.
Sunnyvale, CA 94086
(800) 537-5999
(408) 730-1112
List Price: With 256K, $745; with 512K, $845; with 1MB, $945.
Requires: Serial port.
In Short: A device sharer with six serial ports and basic document control.
CIRCLE 690 ON READER SERVICE CARD

The diminutive Data Manager Data Net 1551 features six serial ports and a 256K buffer that can be expanded to 1MB. Hardware configuration is done through DIP switches inside the box.

In a direct comparison between printer sharing devices, our competition would like to remain anonymous.

- *2, 4 or 6 input ports*
- *Serial or parallel output*
- *0Kb to 1MB of RAM—often soldered, not adaptable for memory expansion*
- *Sequential scanning or concurrent input*
- *Warranty—90 days to one year*
- *Compatible with most printers*

- *Up to eight serial input ports*
- *Serial and parallel outputs*
- *Concurrent input and output for all ports*
- *Easy, menu-driven configuration*
- *Separate baud rate, flow control, parity and messages for each port*
- *Multiple copy command*
- *Priority print command*
- *User-definable print direction*
- *Field expandable memory up to 2MB*
- *Printer emulation codes and prompt/response messages stored in RAM*
- *Automatic top-of-form generation*
- *Self-testing features*
- *Buffer clear, pause and top-of-form controls*
- *LEDs display buffer status, current port activity and printer ready*
- *Optional parallel/serial converter*
- *Compatible with virtually all printers and plotters*
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CIRCLE 166 ON READER SERVICE CARD

put or output with speeds from 300 to 38,400 bps. For output ports, you can send an automatic form feed or Esc-E (for LaserJet resets) at the end of the job, set the handshaking protocol to DTR or XON/XOFF, and make the port bidirectional or receive-only. You can set input ports to select an output port automatically, use a time-out of 15 or 60 seconds, and use DTR or XON/XOFF for handshaking protocol.

Once you've powered up the unit, you can use software commands to input ports to control the Data Manager. Each command starts with a three-character sequence, ">>_", and is followed by the command parameters. You can force a print request to time-out, sending it to the printer immediately, or you can set the time-out period from 0 to 255 seconds. You can override the default output port or send the data to a distribution queue that routes it to the first output device available, starting with the lowest port. You can also print multiple copies of a document.

The user manual we reviewed was a preliminary copy containing just enough information to set up and use the Data Manager. It includes a brief description of the port pinouts, an explanation of the DIP switch settings for input and output ports, and a description of software commands and how to use them. There is also a discussion of the difference between hardware handshaking (DTR/CTS) and software control (XON/XOFF).

There's room for improvement with the Data Manager. The cover that gives you access to the DIP switch is flimsy and difficult to open. Status lights to indicate activity would be a welcome addition. The ability to have both hardware and software handshaking instead of choosing one or the other would help, too.

The Data Manager is a simple device with few frills but all the basics of a good printer sharer. If you only need to share serial printers and occasionally another device, like a modem, the Data Manager may be all you need.

■ The Mega-Link is simple to use with few settings and features to worry about.

INTELLICOM INC.

Mega-Link

Mega-Link, the four-port buffer from Intellicom, is a printer-sharing device for people with simple needs. Resembling an external modem, the Mega-Link has one parallel input port, two serial ports for input or output, and a parallel output port mounted on the rear of the unit. It comes standard with a 256K buffer and is expandable to 1MB.

The Mega-Link is powered by a 17-watt transformer connected to the back of the unit. You configure the port setting with DIP switches mounted on the board inside the metal case. To hook up a parallel port from a PC to the unit, you run a standard parallel printer cable from the computer to the Centronics input port on the back of the device. You can hook up two other PCs to the serial input/output ports on the Mega-Link using female-to-male, straight-through cables with DB-25 connectors. You will need a male-to-male null modem cable with DB-25 connectors to connect a serial printer to the serial input/output ports, and you can use a standard parallel printer cable to hook up the

PC MAGAZINE FACT FILE

Mega-Link
Intellicom Inc.
9259 Eton Ave.
Chatsworth, CA 91311
(818) 882-8877
List Price: With 256K, $349.
Requires: Serial or parallel port.
In Short: An automatic printer sharer with simple features for small configurations.
CIRCLE 689 ON READER SERVICE CARD

The Mega-Link is a four-port buffer from Intellicom Inc. To change settings, you slide the bottom of the case open to expose a circuit board with DIP switches.

10 SECONDS

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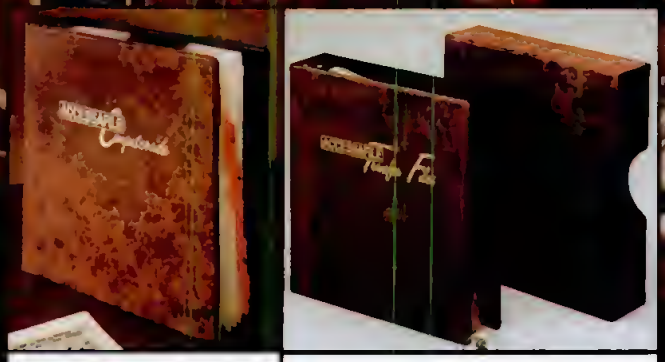

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CIRCLE 185 ON READER SERVICE CARD

parallel output port to your printer.

Instead of including technical details about each setting, Intellicom provides a diagram of 22 possible configurations of PCs and printers that could be hooked up. You find the layout that matches what you want and set the switches accordingly. You can configure up to three PCs as input devices but only two devices as outputs.

The Mega-Link switches ports and printers automatically, and you can't change its operation under software control. On the front panel are four buttons, one for manually selecting your input ports, one for switching manually between output ports, one for "clear," and one for "copy." The clear button pauses or clears the print buffer. The copy button tells the device to send to the printer up to 250 copies of the document being received. Above the buttons are six status lights, one indicating activity for each of the four ports and two for showing that the pause and copy buttons were used.

To change the features of the Mega-Link, you slide the bottom of the case open to expose a circuit board with DIP switches. You can set the Mega-Link to pause before or after each page is printed, a nice feature for single-sheet-feeding printers. It can also be set to send an automatic top-of-form after each job is finished. You can select automatic input mode, and the Mega-Link will sense input activity on a port and connect to it until nothing is received for 15 seconds. If you want to disable the feature, you can set the switches so that the input port can be selected only with the button on the front panel.

The documentation is brief, containing just enough information to set up the device. The configuration diagrams are helpful in setting up your printers, but you have to read the section on selecting options a couple of times to understand it. There are simple explanations for the DIP switch settings, but there are no pinout diagrams in the manual.

The Mega-Link is an automatic A-B-C or matrix switch, and you shouldn't expect much more. The time-out delay is fixed at 15 seconds unless you turn it off by disabling the automatic sharing. You only have one parallel input port, so other PCs must use their serial ports or use a converter, even though they are close enough for a parallel connection. Although you have a 256K buffer, the Mega-Link will automatically split it into two 128K buffers when there are two printers present, instead of sharing it.

The Mega-Link is simple to use, with few settings and features to worry about. If you have only two or three people who need to share a printer, it may be all the printer sharer you need.

QUADRAM CORP.
Microfazer VI

The Microfazer VI is another device in a long line of printer-support equipment offered by Quadram Corp. over the years. A printer-sharing device with four serial ports and two parallel ports, the Microfazer VI can switch the input from one to five computers out to up to five output devices. It comes with a 256K buffer that you can upgrade to 1MB of memory, and you can daisychain multiple units to expand your capabilities.

The flat, rectangular box has six female DB-25 connectors on the back of the unit with a connection for a 35-watt power supply. On the front of the unit you'll find a status light and a reset indicator to the right and a status light for each port to the left. Next to each light is a push button used to configure the Microfazer.

All connections to and from the Microfazer are made with straight-through cables. You use male-to-female cables from the PC to the device and male-to-male cables from the unit to serial printers. Parallel

PC MAGAZINE FACT FILE

Microfazer VI
Quadram Corp.
One Quad Way
Norcross, GA 30093
(404) 564-5566
List Price: With 256K, $695; with 512K, $795; with 1MB, $995.
Requires: Parallel or serial port.
In Short: A versatile printer sharer for both parallel and serial operation.

CIRCLE 680 ON READER SERVICE CARD

Quadram's Microfazer VI accepts data from all its input ports at once and dynamically allocates the buffer memory as needed. Port settings are entered using the buttons on the front panel.

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HEWLETT PACKARD

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CIRCLE 339 ON READER SERVICE CARD

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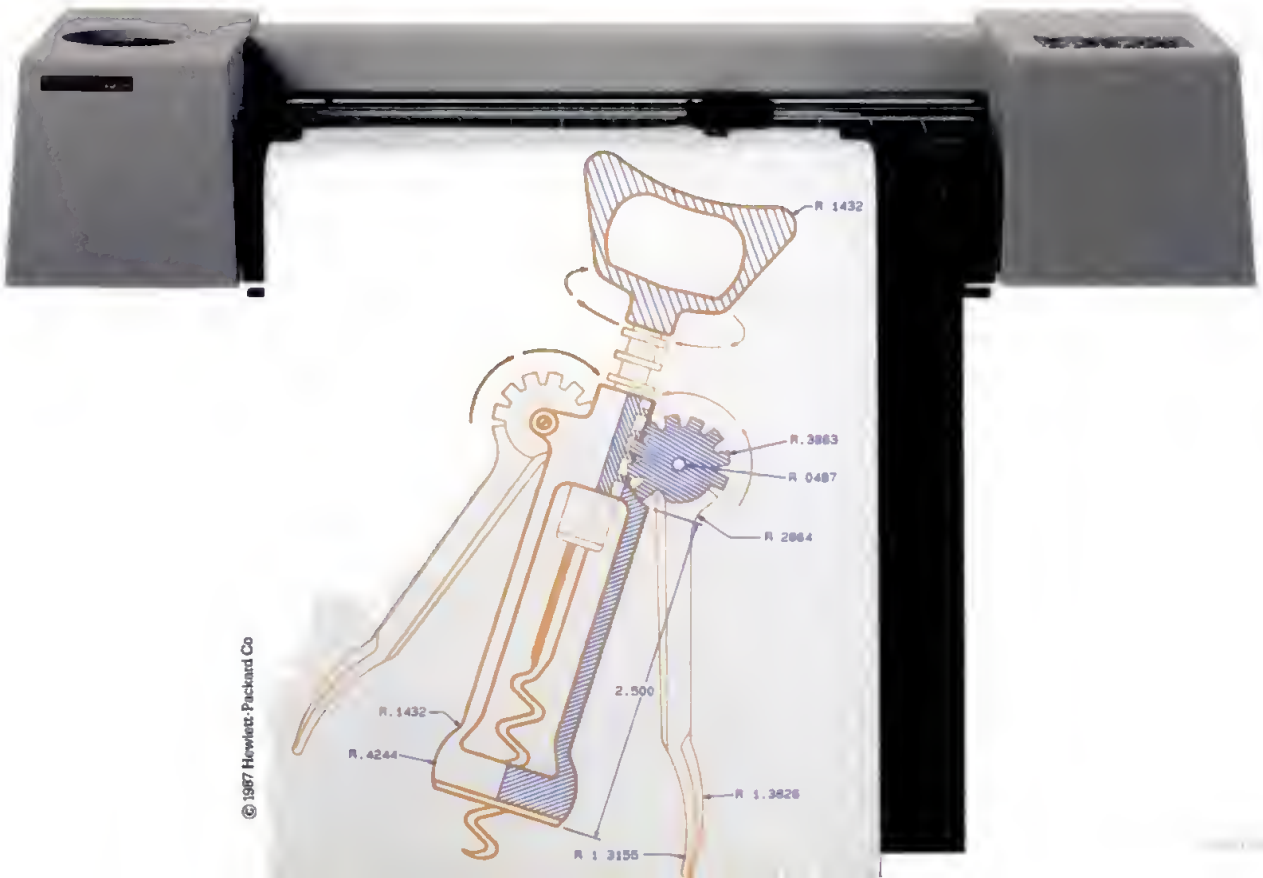

printers are hooked up using standard male-to-Centronics cables. The Microfazer comes factory-configured to share four serial inputs and one parallel input with one parallel output.

Settings for the input ports are entered using the eight buttons on the front of the unit. You push both the status and reset buttons, then let up on the reset button until port 3 and the status light blink. You release the status button and press port 3 to start the configuration. After you press a button to select a port, you can change the baud rate, set a time-out period of 20 to 200 seconds, turn on auto-form-feed, and set the handshaking protocol. Port 6 is always selected as a printer port.

The Microfazer accepts data from all input ports at the same time and dynamically allocates the buffer memory as needed. Print jobs are sent to the printer on a first-come, first-served basis, and the port status light will stay on when there is activity on the line. If a job was buffered, the Microfazer will blink the port light until the job is complete. With the form-feed option set, the unit will check the last character in the job and eject the page if the character is not a form feed. You can clear the device by pressing the reset button on the front of the unit.

The unit comes configured so that all output will go to port 6 automatically. However, if you have multiple output devices, you must use printer-selection codes to select the desired port. The codes start with a Ctrl-T (T) and are followed by the number of the desired port. If you have no specific printer in mind, you select the next available printer by substituting an "X" for the port number. You can send the Microfazer a command to send a string of characters at the beginning and the ending of each print job. The Microfazer has a special temporary graphics mode that disables the commands in case an application sends binary characters that may contain a Ctrl-T. You send two Ctrl-T's and a G (TTG) to the port, and further control codes are ignored until the port times-out. You may have difficulty sending these control sequences with your word processor, so you may have to put the codes in DOS files and send them with the COPY command instead.

The manual is adequate and covers most of the Microfazer's features well enough to troubleshoot problems. Cabling and commands are described well, but the section on setting internal registers is a little brief and somewhat intimidating. The section on selecting printers from within an application incorrectly describes setup strings for *Lotus 1-2-3*, using the Slash key instead of the Backslash. Overall, you should be able to set up the Microfazer without having too much trouble using the manual.

This device is certainly flexible, but it could be easier to use. Many of the other printer sharers use a three-character ASCII lead-in code instead of Ctrl-T to indicate that a command is coming. In this way, all word processors can send the codes without problems. Also, it would almost be easier to have DIP switches instead of using Quadram's push-button scheme to configure the device. Watching registers and toggling settings is a throwback to the Altair days, and many other manufacturers now use screen-oriented setups and pop-up menus.

Once you get the Microfazer set up, it's an easy device to use, especially if you have only one printer. The buffer can be expanded for larger print jobs and has enough ports to handle a typical printer-sharing environment. If you don't mind a sending a few Ctrl-T's to change the device's settings, the Microfazer may be a valid choice for your printer-sharing needs.

ROSE ELECTRONICS
Master Switch

The Master Switch is one of an extensive product line of switching devices offered by Rose Electronics. Billed as a networking switch, the Master Switch controls and buffers nine serial devices including computers, printers, and modems. You attach serial input devices to the unit using null modem cables. Since you can have a variety of serial output devices, Rose Electronics offers numerous cables for use on the Master Switch.

On the front of the rectangular metal case is a green power light and two buttons, one for selecting ports and another for advancing paper. In addition, there are three red status lights and nine red port-status indicators that show activity on the lines. On the back of the unit is a receptacle for a 12-watt power supply and nine female DB-25 connectors for attaching cables.

■ The Master Switch is very sophisticated. It provides you with just about any feature you could possibly want on a serial device sharer.

You change the characteristics of each port by attaching your PC to port 0. Using a communications program such as *Crosstalk* or *ProComm*, you activate the unit by sending the command "!@C". The Master Switch will respond with a prompt for commands, and you assign unique settings to each port. You specify a time-out period of 0 to 255 seconds, give each port an eight-character name, modify the command sequence to a code besides "!@", and identify the port as a computer, printer, or modem. You set up a default destination for each input port, and you can enable or disable time-outs for nonprinter output ports, set the communications speeds of each line, establish a string to be sent before each job, and configure the port to send a form feed at the end of the job if desired. Each port can also be assigned a high or low priority.

The Master Switch is a very sophisticated device sharer. Although the form-feed option is set, the Master Switch will check the last character and send a top-of-page command only if it is not a form feed. The buffer can store up to 64 jobs in a queue, and it dynamically allocates as much memory as a port needs to complete a job. It understands the signal difference between a printer and a modem, and you can set any two ports for uninterruptible operation. It also supports both XON/XOFF

The Master Switch from Rose Electronics controls and buffers nine serial devices including computers, printers, and modems. The buffer can store up to 64 jobs in a queue.

protocols and hardware handshaking.

The Master Switch will accept some of the configuration commands mentioned above from any input port. Using a word processor or DOS text file, you can change the destination port, time-out, and communications rates. You can print the status of each queued job and cancel one if necessary. To make things easier, you can buy a package from Rose called *Master Link*, a memory-resident program that pops up inside your applications and sends commands using the PC function keys. You can set up each key with a description and a command sequence and use them to send the commands to the Master Switch.

Rose Electronics has created an excellent user manual. In 25 pages it clearly describes the signals required for parallel and serial cabling and what you should expect from the switch. It describes the configuration process simply and explains each command clearly. There is a command summary in the back.

The Master Switch provides you with just about any feature you could want on a serial device sharer. It also comes in different mixes of serial and parallel ports so you can easily match it to your current configuration. When you add a little more memory to the standard 64K buffer, this becomes a device worth investigating.

FACT FILE

Master Switch
Rose Electronics
P.O. Box 742571
Houston, TX 77274
(713) 933-7673
List Price: With 64K, $749; with 256K, $849; with 512K, $949; with 1MB, $1,149.
Requires: Serial port.
In Short: A full-featured device sharer that controls up to nine serial devices.

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SERVER TECHNOLOGY INC.

EasyPrint EP-700

The EasyPrint EP-700 is one of many devices from Server Technology that take a different approach to sharing printers. Instead of building a box with firmware to control buffering, baud rates, and setup codes, the EP-700 uses a PC with special software as a server to control one serial printer and one parallel printer.

The main component of the EP-700 is a CrossPOINT switch, a metal-enclosed control switch that's a little larger than a pocket dictionary. The switch has eight status lights on the front of the box for monitoring activity on each port and a connector for the 5-watt power supply. On the back are eight modular jacks for seven input devices and one output device. The EP-700 depends on a central PC to buffer and send output to the printers.

To start your system, you designate a PC with a hard disk as a hub PC. You install a COM-2 board, supplied with the EP-700, to add two more communications ports to the hub. A flat, six-wire cable from a DB-9 connector on one of the ports connects the PC to one of eight modular jacks on the switch. Another flat cable from port 8 on the switch to the second port on the COM-2 board sends output back to the hub PC. Once you've installed the hub, you can connect up to six more PCs to the back of the device using six-wire cables and DB-25 or DB-9 connectors provided with the package.

The EP-700 comes with seven floppies, one for each PC on the switch. You install and run memory-resident software on the hub PC to control the printers attached to COM1 and LPT1, using about 50K in the process. On each satellite PC, you use a slightly different command to activate similar memory-resident software, using about 20K, to control your printer output to the hub. When you send information to your printer port on a satellite, the software reroutes the data to the switch; the data is then sent to the COM-2 board on the hub PC. The software on the hub PC spools the information first to the hard disk and then to one of its printers.

The EP-700 comes with two manuals, an installation and quick setup guide and a reference guide. The installation guide is very brief, showing a picture of the way the PCs should be hooked up, some simple instructions for connecting the cables, and a short description of how to start the software. The reference guide gives you two pages on installing the hardware and six pages on installing the software. The remainder of the manual describes the software that runs on the hub and satellite PCs.

There are few special features in the EP-700. On the hub PC you can specify an initialization file and a termination file for each printer that will contain characters to be sent at the beginning and end of the job. On the satellite PC you can indicate which printer or hub will receive the data, and the time-out period needed to determine the end of the transmission. The EP-700 software also has forms control, which will stop the printing until you change the forms in the destination printer.

The EP-700 is a little bit clumsy and not really made for the first-time user. The

The EasyPrint EP-700 from Server Technology uses a PC as a server to control one serial printer and one parallel printer. You can attach up to seven satellite PCs to the server.

PC MAGAZINE FACT FILE

EasyPrint EP-700
Server Technology Inc.
140 Kifer Ct.
Sunnyvale, CA 94086
(800) 232-7729
List Price: $899.95
Requires: One serial port per PC and one PC with a hard disk and a serial and parallel port.
In Short: A communications switch with a network look and basic features.

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PC WEEK

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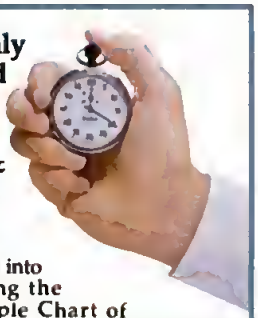

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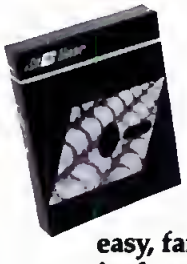

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PC MAGAZINE

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CIRCLE 107 ON READER SERVICE CARD

manual spends a lot of time dealing with hardware interrupts and port addresses. The section on error messages suggests that you use DEBUG in some cases to troubleshoot problems. The forms-control feature requires you to leave your application and run a program to change the form and send a disk file to the hub. If you are the owner of the hub and the printer is busy, the manual warns you to expect a beep because it can't spool your output. Not only do you lose 50K on the hub, but your software must share the CPU with the memory-resident software that's cranking out reports.

The EP-700 uses virtual printers and hard disk spooling in much the same way a network does, without the high cost. However, many of the other printer sharers have better features and large, sophisticated buffering capabilities. You may want to look at alternatives to the EP-700 if you want to do your printing tasks without tying up your PC resources.

VIA-WEST INC.

Via-West CA-4

The Via-West CA-4, from Via-West, is one of four device sharers available from the Tucson-based company. Enclosed in an austere 3- by 9- by 9-inch gray box, the unit has four serial ports that share one master serial port. On what appears to be the back of the unit is a power cord for the built-in power supply and a DB-25 female connector for the master serial port. The other end of the unit has four DB-25 female serial ports, a power indicator light, and a status light for each of the four ports.

You connect your PC serial port to the CA-4 with female-to-male null modem cables. From the master switch you run a male-to-male cable that crosses pins 2 and 3 and connects pin 5 on the CA-4 to pin 20 on the printer. To set all of the port characteristics, you must remove four screws to open the case and access the jumpers and DIP switches inside the unit. No software commands modify the ports.

There are very few parameters that can be changed on the CA-4. You can set the baud rate from 150 to 19,200 and adjust parity, data bits, and stop bits. The time-out period at the end of the print job is set for 1.7 seconds and adjustable from .105 to 13.4 seconds. Requests to send and clear to send can be set for hardware handshaking or XON/XOFF codes. You can change the master port to a different port.

The Via-West CA-4 has a master serial port that scans four ports and locks onto the first transmission signal it receives, then completes the job before moving to the next signal.

When used as a printer sharer, the CA-4 scans the four ports for the first CTS received from the input device, locking onto it until the transmission is complete. In the address mode, you send a one-character control code to the unit and it will lock the master port onto the port indicated by the code. The unit can now transmit in both directions. Using jumpers, you can select printer sharing, address mode, or both.

The documentation provided with the CA-4 is very short and very technical. It goes into great detail about voltages, dwell times, and EPROM settings for changing control codes. There is also a two-page summary that again describes in technical terms the functions of the CA-4. The summary also has a diagram showing pinouts and cable configurations for attaching PCs and printers to the device.

The CA-4 is not for the timid user. It takes a hardware technician to explain

PC MAGAZINE FACT FILE

Via-West CA-4
Via-West Inc.
Tucson, AZ 85705
(602) 623-5716
List Price: $450
Requires: Serial port.
In Short: A simple, no-frills device sharer for serial equipment.

CIRCLE 685 ON READER SERVICE CARD

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Graphics *by Signature* *NB24-15*

Text *by Signature* *NB24-10*

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CIRCLE 356 ON READER SERVICE CARD

much of what the manual says. Once you do figure it out, you'll find that it has few capabilities other than switching four ports to one printer or possibly sharing a single modem. Using jumpers and DIP switches makes it difficult to reconfigure the CA-4 if the shared device changes. With cables coming out both ends of the box, it is also hard to arrange the cables on your desktop in an orderly fashion.

The Via-West CA-4 is a basic device switch for simple sharing applications. You get no frills, no buffering, and few features to streamline its operation. Leave this one to the experts.

The Lasernet Model PSU-82C from Western Telematic comes with a built-in power supply and two setup switches for configuring the ports. Ports can also be set with software commands.

WESTERN TELEMATIC INC.

Lasernet Model PSU-82C

The Lasernet Model PSU-82C is one in a series of printer sharers available from Western Telematic, a company with 23 years of data communications experience. Not much larger than an 80-column dot matrix printer, the Lasernet has eight serial input ports and one serial output port, all using DB-25 connectors, and an additional parallel output port using a Centronics interface. The box is solid and well constructed, with the ports evenly spaced at the back of the unit, and status lights, control buttons, and port-busy indicators displayed on the front.

The Lasernet comes with a built-in power supply and two setup switches on the back of the unit for configuring the ports. To connect your PC, you use your existing printer cables to plug into the back of the device. You can then connect the unit to a parallel port on the back of your printer with a Centronics-to-Centronics parallel cable, or to a serial connection with a straight through, male-to-male cable. Lasernets can be daisychained by connecting the serial output port to a serial input port on another Lasernet.

Port configurations can be set up using DIP switches in the back of the unit or with software commands. With the switches, you can set the default communications parameters for all the input ports and the default output port. In addition, you can establish the initial settings for the time-out period before Lasernet selects another port and for sending top-of-forms at the end of a job. Once you've set the switches, you press the buttons on the front of the unit to write the new settings into the Lasernet memory.

Since the DIP switches set all the ports to the same state, you must send software commands to Lasernet to customize the configuration. Commands start with a five-character sequence, "[:]I,", and are followed with abbreviations for changing communications parameters, start-of-job and end-of-job messages, time-out delays, and printer reset commands separated by commas. You can also use them to switch between the parallel and serial printer. You can send the commands with your word processing document, with DOS TYPE and COPY commands, or with LASERNET.EXE, a simple interactive program that helps you build the command strings and send them. An optional memory-resident program, QTERM, is also available to perform the same function. Each Lasernet can hold up to 2MB of memory, and it can accept and buffer input simultaneously from all eight input ports.

To expand the number of devices sharing a printer, you can connect the serial output port from one Lasernet to a serial input port on another. The status lights in front of the device indicate which port is sending, as well as the amount of buffer memory that is still available.

PC MAGAZINE FACT FILE

Lasernet Model PSU-82C
Western Telematic Inc.
5 Sterling
Irvine, CA 92768
(800) 854-7226
(714) 586-9950
List Price: With 256K, $995; with 512K, $1,095; with 1MB, $1,195; with 2MB, $1,495.
Requires: Serial port for configuring ports.
In Short: A full-featured printer sharer with good expansion capabilities and support.
CIRCLE 684 ON READER SERVICE CARD

PC MAGAZINE EDITOR'S CHOICE

- Logical Connection
- PrintDirector MS-10SP

Your choice of device sharer or printer sharer will depend on your PC environment and the problem that you are trying to solve. A work group with low-volume output and simple word-processing requirements may need only a simple box with many input ports and no job controls, sharing a single laser printer. Others may need to share sophisticated laser printers for desktop publishing, as well as modems and plotters that require switching between serial devices and faster parallel devices.

Shared environments seldom remain static, and the sharing equipment should be able to handle changes easily. It should be easy for the user to switch devices and control printers from within an application without having to learn and use technical commands.

Because of their depth of features, expandability, and streamlined user interface, we chose the Logical Connection and PrintDirector MS-10SP as Editor's Choices.

Fifth Generation Systems' Logical Connection brings flexibility and ease of use to the complicated world of device sharers. For $495, you get a printer buffer, a serial-to-parallel converter, and PC-to-PC connections all in one box. You can combine a variety of serial and parallel input and output devices and tie multiple Logical Connections to build a sophisticated network of shared peripherals. Powerful software smooths the setup of each device, and pop-up menus make it a snap to change devices.

For the dedicated printer sharing environment, the PrintDirector MS-10SP from Digital Products is a heavyweight in a crowded arena. The MS-10SP gives you valuable front panel controls and indicators, easy-to-use setup software, a large buffer, and powerful job control features. The six serial ports and four parallel input/output ports give you tremendous flexibility in connecting PCs to printers and maximizing their use. The $1,395 price tag isn't trivial, but the sophistication of this product is worth the price.

The documentation is brief, but it contains enough information to help you use the Lasernet properly. You are provided with pinouts, suggested configurations, and part numbers for ordering the cables that you will need to complete your connections. Instructions for sending commands are simple but easy enough to follow once you understand their methodology.

The Lasernet is well thought out, with few shortcomings. It comes with a worksheet to help you configure the ports, but you need to understand communications terminology to really do it right. Although you can specify time-outs from ¼-second to 5 minutes, you are limited to ten predefined time-out periods. Since the DIP switches affect all ports, you are forced to use somewhat simple software to customize the device. However, with a little help from some of your fellow PC users, you should be able to deal with these items.

The Lasernet is a no-nonsense, full-featured printer sharer that's good at its job. It lets you know what's going on, and it seems to handle up to eight serial devices quite well. PC

Mike Falkner is an independent microcomputer consultant in Orangevale, California. He contributed to PC Magazine*'s special accounting issue (September 15, 1987).*

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Watson®

Natural MicroSystems Corporation

CIRCLE 507 ON READER SERVICE CARD

How To Easily Start A Feeding Frenzy.

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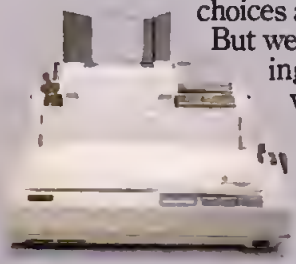
But if you're looking for a printer that's not only fast, but can easily devour any job you throw at it, you'd best look at the new Toshiba P351SX 24-pin dot matrix printer.

Take envelopes, for example. The P351SX comes with an optional automatic envelope feeder. That way your envelope is printed with the same speed and ease as your document.

We even replaced the hassle of dip switches with our new front panel. So you can make all your choices at the touch of a button.



But we wanted to make your printing jobs even easier still, so we added a few more convenient features.

Like the unique ability to print six-part forms with each part as legible as the first. Plus a built-in tractor and tear bar. A fanfold bypass. An autoload lever. A multistrike film ribbon. IBM Proprinter and Graphics Printer,[1] Qume Sprint 11,[2] Toshiba and other popular printer emulations. And a 64K buffer.

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[1]IBM and Proprinter are registered trademarks of International Business Machines Corporation. [2]Qume Sprint 11 is a registered trademark of Qume Corp.

In Touch with Tomorrow

TOSHIBA

Toshiba America, Inc., Information Systems Division

MAKING CONNECTIONS

Waterloo Port

Historians associate Waterloo with defeat, but the Waterloo Port local area network is a winner. It provides a sophisticated graphics interface and shared resources in a LAN environment.

FRANK J. DERFLER, JR.

To most Americans, Waterloo is the place where Napoleon met defeat. But when Canadians hear the name Waterloo, they think of high tech. The University of Waterloo in Waterloo, Ontario, is the launching pad for many high-tech enterprises. One of its best-known academic/commercial enterprises is a set of fast FORTRAN compilers for IBM mainframe systems. A relatively new export from those hallowed halls is a local area network operating system named *Waterloo Port*.

Port was developed in 1980 as a research project in real-time portable operating systems that could be moved to various processors. When the project was spun off as a corporate venture, the designers applied the architecture of the operating system to a network for personal computers. Waterloo Microsystems now has offices in Atlanta, and it markets versions of the *Port* network operating system for its own ARCnet and IBM's Token-Ring networking hardware. The Waterloo Port network, which includes the *Waterloo Port* operating system and Waterloo ARCnet, competes head-to-head with networks marketed by Novell, 3Com, IBM, and other companies.

Like IBM's PC LAN, Waterloo Port is a peer-to-peer network. Every workstation can share its internal hard disk drives, printers, and other peripherals with stations through the network. Unlike the situation with the IBM network, however, the shared drives must be formatted in the special *Port* operating system format. DOS-configured drives cannot be shared. Each workstation can host up to

FACT FILE

Waterloo Port
Waterloo Microsystems
3597 Parkway Ln., #200
Norcross, GA 30092
(404) 441-9252
List Price: Waterloo ARCnet card, $595; *Waterloo Port* (5-station-maximum configuration), $1,895; *Waterloo Port* system upgrade beyond 5 stations, $995; Waterloo 512K RAM card, $695; Waterloo 1MB RAM card, $995; ARCnet active hub, $795, ARCnet passive hub, $115.
In Short: This local area network hardware and software system allows every workstation to contribute resources to the network and run several *Port* applications simultaneously. It is far removed from MS-DOS, however, and requires significant training to install and maintain. Best suited for developers of multitasking software for vertical applications.

CIRCLE 655 ON READER SERVICE CARD

three printers and share them through the network. This restriction gives you the first hint that Port is a very "un-DOS-like" network.

Waterloo Microsystems sells special RAM expansion cards for use on servers and workstations. The purpose of the cards is to get the *Port* software out of the DOS address space. With one of these cards ($695 for 512K) in a workstation, you have a full 640K RAM open for applications.

These Waterloo memory cards do not respond to the standard EMS configurations, and standard EMS cards cannot be used as the main address for the *Port* operating system. Nonetheless, EMS cards from Intel and other companies function normally in *Port*-equipped workstations. The Waterloo memory cards can interface with the AT's 16-bit wide bus or with the 8-bit bus of the PC. The *Port* documentation includes a memory map of the AT that is helpful in setting the memory locations for the Waterloo RAM expansion cards and other cards.

The technique of tucking the network's operating system away in its own dedicated memory is unique among today's PC-based networks. Some network operating systems steal almost 200K of RAM from the applications. *Port* leaves every byte DOS will address free for applications, but you must pay the price for the extra RAM card. If you don't buy the Waterloo added-memory card, a minimum of 182K of system RAM and probably a lot more (depending on the number of shared files and printers) is taken by *Port*. Moreover, DOS and the application program use memory on top of the minimum used by *Port*. The bottom line: without added memory, you can't run many useful programs.

There is a version of *Port* for the IBM Token-Ring Network and a version for Waterloo's own ARCnet network hardware. With *Port*, you can't mix cards in the same machine to form an internal network bridge, as you can with the Novell and Banyan network operating systems. Waterloo offers an optional *Port Internet Gateway* software package that will join multiple Waterloo ARCnet and IBM Token-Ring networks. The *Port* operating system works only with the ARCnet and Token-Ring interface cards, not with those of other manufacturers.

Like Novell's *NetWare* and Banyan's *VINES*—and unlike IBM's *PC Local Area Network Program* and other MS-DOS–based products—*Port* really is a multitasking operating system. Unlike any other network operating system, *Port* puts this multitasking environment on every station in the network. The *Port* software in every station emulates NETBIOS and executes DOS calls. DOS is one task running in a multitasking environment.

Multitasking applies only to *Port* applications, and there are few of those. *Port* won't let you run two DOS applications on the same workstation at the same time.

Our experiences with DEC VMS and AT&T UNIX systems using the same techniques on only the server ("Making Connections: DEC Meets DOS," *PC Magazine*, September 29, 1987, and "Making Connections: AT&T's 3B2/600 and StarLAN," October 27, 1987) show that when operating systems pass calls to other operating systems, the response time slows down. It is no surprise, then, that performance is a major limitation of the Port system. Our benchmark test results show Port's performance times to be much slower than those of competing products like 3Com's EtherLink network or an IBM

The Connectivity Decision Guide

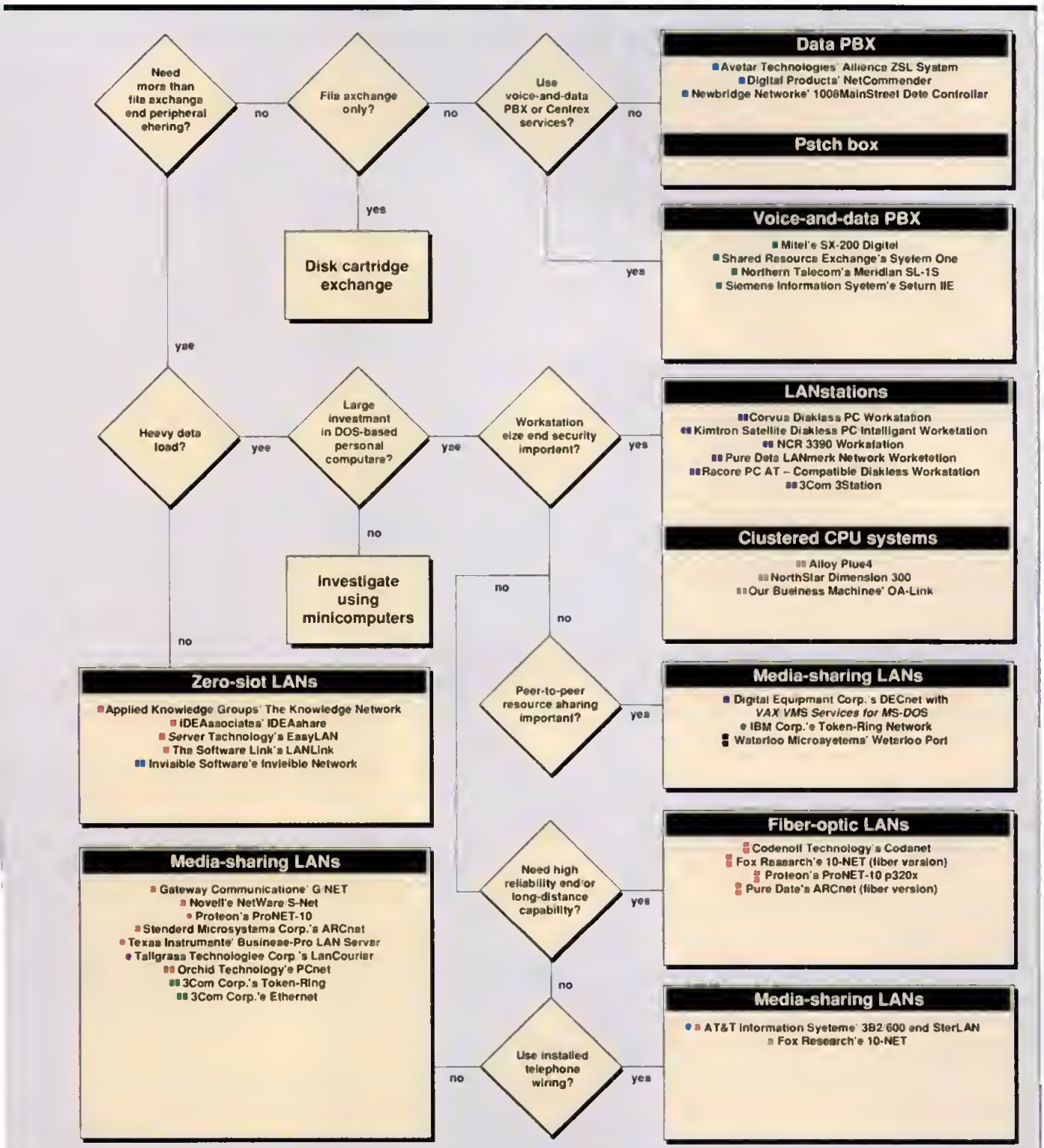
This chart is designed to help you select from among the many information-transfer and resource-sharing alternatives. As you can see on the chart, if all you really need to do is exchange files or share printers, then you should consider devices such as PBXs and patch boxes. If your organization has not already invested heavily in PCs or DOS programs, then a minicomputer might meet your needs more economically. But if you want many users to share data files simultaneously under DOS, a LAN may be the best alternative. Once you've decided on a LAN, the need for station-to-station resource sharing and other factors will influence your network purchasing decision.

Because manufacturers include many different features in their networks, some products will not fit neatly into one decision box in this guide. You'll also find that the lack of differentiation between LANs is becoming as large a problem in the LAN industry as the lack of standards was 2 years ago. But overlapping features and technical similarity between networks are good news for potential buyers. They will let you concentrate on more-traditional factors such as dealer support and price instead of on more-technical considerations.

Reviews originally appeared in *PC Magazine*:

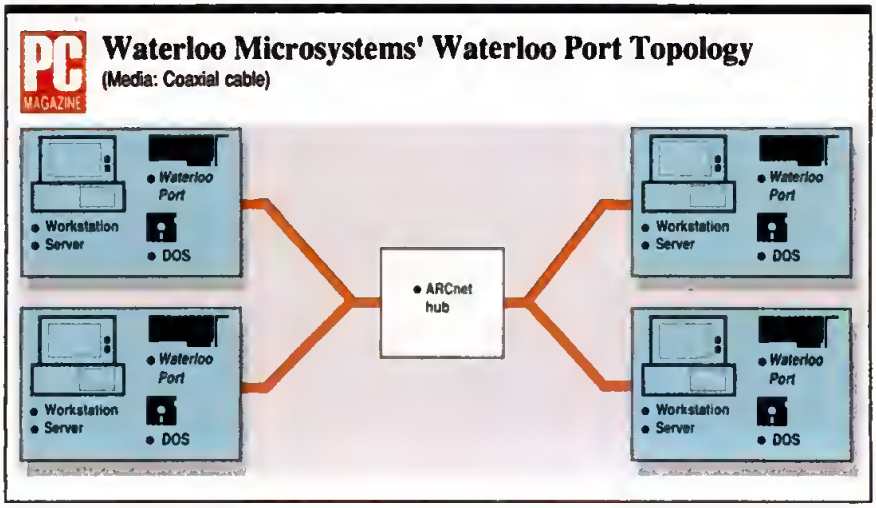
- December 9, 1986
- December 23, 1986
- January 13, 1987
- January 27, 1987
- February 10, 1987
- February 24, 1987
- March 31, 1987
- April 14, 1987
- May 26, 1987
- June 9, 1987
- June 23, 1987
- July 1987
- August 1987
- September 29, 1987
- October 27, 1987
- January 12, 1988
- January 26, 1988

Black marker indicates current issue


Need more than file exchange and peripheral sharing?
no
File exchange only?
no
Use voice-and-data PBX or Centrex services?
no
Data PBX
Avatar Technologies' Alliance ZSL System
Digital Products' NetCommender
Newbridge Networks' 1006MainStreet Data Controller
Patch box
yes
Disk cartridge exchange
yes
Voice-and-data PBX
Mitel's SX-200 Digital
Shared Resource Exchange's System One
Northern Telecom's Meridian SL-1S
Siemens Information System's Saturn IIE
yes
Heavy data load?
yes
Large investment in DOS-based personal computers?
yes
Workstation size and security important?
yes
LANstations
Corvus Diskless PC Workstation
Kimtron Satellite Diskless PC Intelligent Workstation
NCR 3390 Workstation
Pure Data LANmark Network Workstation
Racore PC AT – Compatible Diskless Workstation
3Com 3Station
Clustered CPU systems
Alloy Plus4
NorthStar Dimension 300
Our Business Machines' OA-Link
no
investigate using minicomputers
no
no
Peer-to-peer resource sharing important?
yes
Media-sharing LANs
Digital Equipment Corp.'s DECnet with VAX VMS Services for MS-DOS
IBM Corp.'s Token-Ring Network
Waterloo Microsystems' Waterloo Port
no
Zero-slot LANs
Applied Knowledge Groups' The Knowledge Network
IDEAssociates' IDEAshare
Sense Technology's EasyLAN
The Software Link's LANLink
Invisible Software's Invisible Network
Need high reliability and/or long-distance capability?
yes
Fiber-optic LANs
Codenoll Technology's Codanet
Fox Research's 10-NET (fiber version)
Proteon's ProNET-10 p320x
Pure Data's ARCnet (fiber version)
Media-sharing LANs
Gateway Communications' G/NET
Novell's NetWare S-Net
Proteon's ProNET-10
Standard Microsystems Corp.'s ARCnet
Texas Instruments' Business-Pro LAN Server
Tallgrass Technologies Corp.'s LanCourier
Orchid Technology's PCnet
3Com Corp.'s Token-Ring
3Com Corp.'s Ethernet
no
Use installed telephone wiring?
yes
Media-sharing LANs
AT&T Information Systems' 3B2/600 and StarLAN
Fox Research's 10-NET

Photograph: Richard Lakin

Waterloo Microsystems markets a network based on the ARCnet standards. Network interface cards in every station connect to a hub that is either active (powered) or inactive. The Waterloo Port *networking software resides in every workstation, and DOS runs as an application under* Port. *Every station on the network can act as a server, contributing hard disk drives, printers, and other devices to the network. But only drives formatted under* Port *can be shared.*



PC AT server running Novell's *Advanced NetWare/286*.

Port's unique file structure is (like those of UNIX and DOS) an inverted tree with a root and branches. In the *Port* system, files are designated as firm types of files at the time of creation; this is in contrast to the use of extension names as in DOS. Permission files, for instance, are specific types of files that can exist on any and all machines in the system.

Port emulates the commands and functions of NETBIOS. This means that network communications gateways, electronic-mail programs, and other applications and communications functions using NETBIOS will run under *Port*.

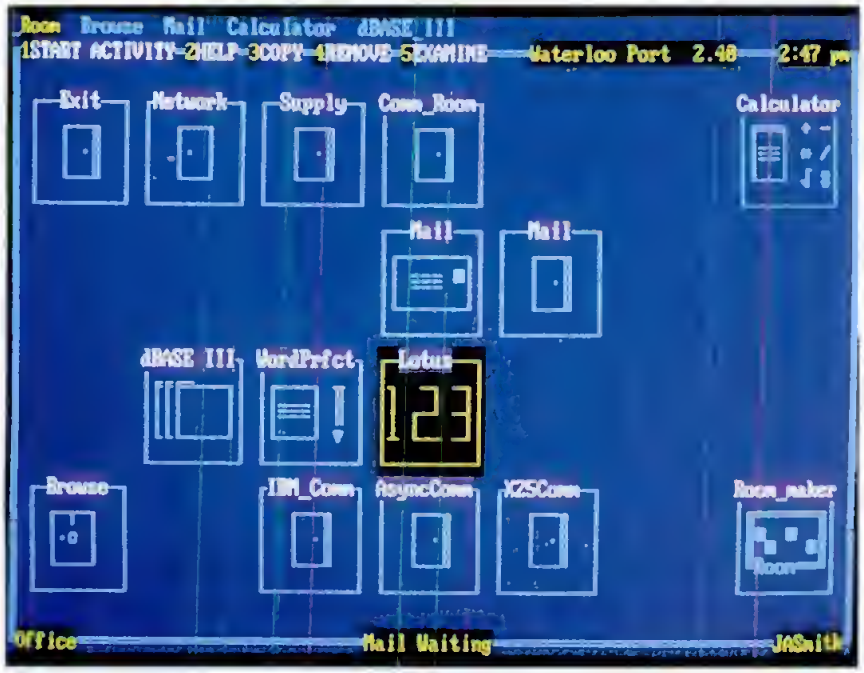
After our evaluation, Waterloo announced X.25 and asynchronous gateway products for *Port*. According to the announcements, neither of these options requires a workstation dedicated to the gateway task.

GRAPHICS INTERFACE Despite its large-computer, dumb-terminal, and command-line-driven heritage, *Port* has a sophisticated graphics interface. This interface doesn't borrow from *Windows*, the Macintosh, or any other typical PC-related design. Instead of using the desktop analogy common to micro applications, *Port* bases its interface on the concept of an office suite through which you gain access to the resources of the network.

The initial *Port* screen represents a suite of offices with doorlike icons leading to various functions and applications. Each user must present credentials (a password) on entering the suite. After you pass through an office door (which, of course, can be locked by the administrator), the screen changes and provides a representation of filing cabinets, printers, and other pieces of useful office furniture.

The icons eliminate the need to remember a command and type it. They provide a single-stroke solution to the question of how to start an application—and a visual cue as a memory aid. Some users love them, and others hate them. But those who don't like icons don't have to use them. You can pass commands to the networking operating system through the keyboard or from batch files.

Icons come in two flavors: doors and



Port *has a sophisticated graphics interface. The screen above depicts two different kinds of icons: doors and activities, which lead to various functions and applications.*

activities. The doors lead to rooms where other activities take place. When an icon is selected, the monochrome image changes to bold characters; the colored image turns yellow.

The icons have parameters tailored to the users. The user ID carries the information used by the *Port* operating system when an icon is selected. Individuals other than the system administrator are encouraged to arrange and use the icons themselves. The icons are contained in an icon library, and they can be created with any text editor that produces ASCII files. The *Port* operating system includes a nice editor that can be used for this purpose.

The file behind an icon provides the file names of the office contents, a label for the icon, the name of the file where the picture for the icon resides, the help file that is called if you request help for this icon, and the command executed when you select the activity. The file containing the icon also includes information that lets you remove, copy, move, and examine it.

Since the system builds *Port*'s icons with ASCII characters, a PC running in this network doesn't need a color monitor or a graphics interface card. Our test-bed LAN used several workstations equipped with standard IBM PC monochrome video monitors.

You don't need a mouse to use *Port*, but it helps. The mouse driver in *Port* is ballistic and provides what *PC Magazine* columnist John C. Dvorak calls accelerating accelerations. The faster you move the mouse, the farther the cursor goes. If you don't use a mouse, the ring menu on the top of the *Port* screens responds to the special function keys.

The *Port* graphics system runs multiple windows. The program doesn't use a tiling scheme, however, and a window always occupies the entire width of the screen. You vary the height of the window using the Plus and Minus (grow and shrink) keys. If several windows are on the screen simultaneously, they appear as strips across the screen. Whenever a window is removed from the screen, any windows below it move up, so the unused space on the screen is always at the bottom.

One line on the screen is reserved for a list of windows, and you can always indicate the window you want to use. The user interface is designed with consistency in mind: windows, applications, and options are always selected the same way.

The bad news is that the *Port* window system works only for *Port* applications such as the integrated text editor. Since DOS applications are run as close to the "native" mode as possible, a DOS session takes up the full screen. You could edit 15 files at once with *Port*'s word processor, but one *WordStar* editing session takes the entire attention of the screen.

You don't have to use the *Port* icon interface. When you configure a workstation in the network, you decide whether that station will see the graphics interface or simply move into an application. You are also offered a choice at boot time, so you can choose whether you want to enter the *Port* LAN or whether you just want to run local DOS applications.

UTILITIES The *Port* operating system has good built-in utilities, including a pop-up calculator and a full-screen text editor. The calculator provides the basic math operations, plus many scientific functions such as degrees, radians, log, and arc.

The editor is handy for creating and changing command files and DOS batch files. It is relatively simple to use, but powerful enough to include word wrap, block moves, justification, and centering. The special-function keys represented in a menu at the top of the screen select many of the program's tasks. The *Port* text editor includes a mouse interface, handy for block moves and other functions.

The multitasking aspect of *Port* comes home to you when you initiate an activity called browsing. Browsing is a very sophisticated version of what happens when you type DIR in DOS with several different criteria attached. The concept in *Port* is that you initiate a browse activity over an entire hard disk or a subset of a hard disk using certain criteria. You can then initiate a browse over the same files using a different criterion in another window. When the selected files are displayed in a window, the special-function keys allow you to select functions such as editing files with the *Port* editor, creating and erasing files, and climbing up or down the file structure.

INSTALLATION The *Port* system's manual is covered in soft Canadian elk skin, which is just as well because you'll

A lot of computer for your money

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Base System **$1129**

12MHz 80286 processor, 1MB RAM, 1.2MB floppy drive, dual floppy/hard drive controller, 200-watt power supply, keyboard.

- **With 40MB HD MiniScribe, 28ms** **$1679**
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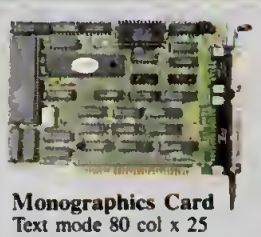

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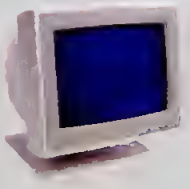

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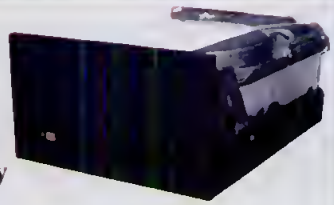

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Benchmark Tests: Waterloo Port

The Waterloo Port networking system turns in significantly slower times than other networking products we have tested. The slow response most likely results from the detailed interaction of the layers of DOS and *Waterloo Port* operating systems. Performance doesn't degrade markedly as more workstations are added, but the system starts slow and stays slow.

Network Speed Under Load

Performance Times
(Times given in seconds)

Server	Interface card	Software	Zero stations	One station	Two stations	Three stations	Four stations	Five stations
8-MHz IBM PC AT	Waterloo ARCnet	*Waterloo Port*	1,144	1,153	1,222	1,315	1,402	1,488
3Com 3Server3	EtherLink	*3+Share*	306	432	529	651	781	868
8-MHz IBM PC AT	EtherLink	*Advanced NetWare/286*	264	280	301	310	322	345

Hard Disk Access Load

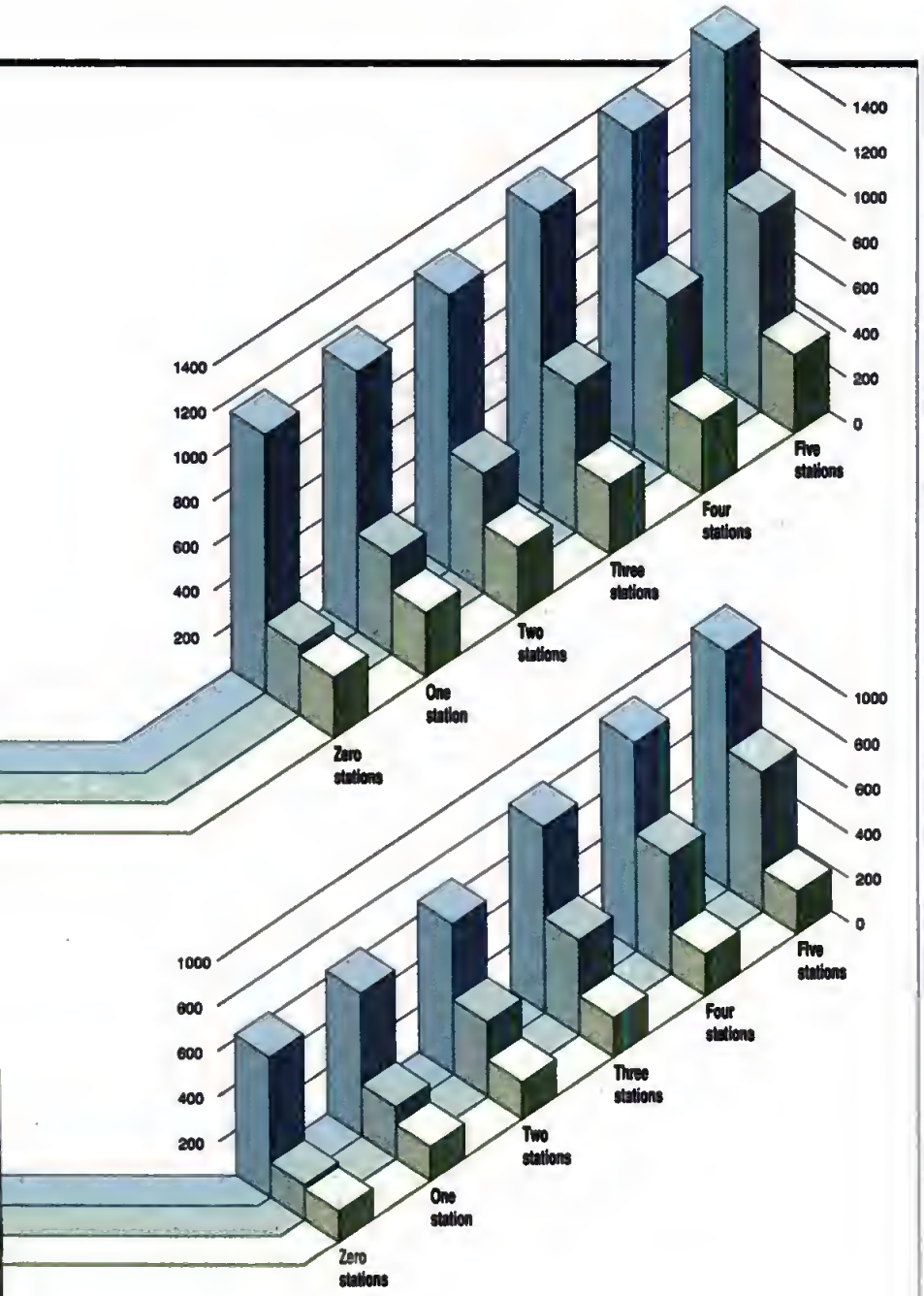
Performance Times
(Times given in seconds)

Server	Interface card	Software	Zero stations	One station	Two stations	Three stations	Four stations	Five stations
8-MHz IBM PC AT	Waterloo ARCnet	*Waterloo Port*	620	632	665	828	927	1,056
3Com 3Server3	EtherLink	*3+Share*	155	227	330	419	522	620
8-MHz IBM PC AT	EtherLink	*Advanced NetWare/286*	136	150	162	174	182	187

The PC Labs LAN benchmark tests are written in C and are independent of commercial software. We ran the tests on a test-bed of five 8-MHz IBM PC ATs. For our test-bed to better simulate the conditions on a medium-size network of 20 or more workstations, we have designed these loading tests so that a single station represents five to ten times the load of a user performing an interactive task (for example, updating records) on a network.

By themselves, the elapsed times reported in these tests are not meaningful. They are valuable only when used to compare the performance of two or more systems running under near-identical conditions. Accordingly, we include the tests run on our Editor's Choice configuration of a 3Com 3Server3, *3+Share* software, and EtherLink interface cards to provide a point of comparison. We also show results from a network of Novell's *Advanced NetWare/286*, EtherLink cards, and an IBM PC AT as the server. *Advanced NetWare* is our Editor's Choice for networking software, and our tested configuration is a typical one.

The **Network Speed Under Load** and the **Hard Disk Access Load** benchmark tests measure the time needed to perform a standardized task on the network. While the actual work loads used for these two tests (described later) are different, we used the same procedures for both. To obtain the elapsed times shown here, we ran a benchmark program performing a sequential create, a sequential write, a sequential read, a random write, and a random read of a large file. The record sizes used in these activities systematically rotate between



16K, 4K, and 512 bytes. The numbers shown in the three-dimensional chart are the total time necessary for all of these operations. We ran the test on all our ATs to load the network while timing just one of them. We then reduced the number of workstations one at a time to show the effect of loading on the network.

The **Network Speed Under Load** test puts a heavy load on the network interface (cards, media, and so forth) while placing a minimal load on the hard disk by having each station continuously read and write its own 1-byte data file, changing the data each time. For systems with disk caching, the load on the hard disk is even smaller, since cached systems typically perform a disk write but do not require a physical disk read.

The **Hard Disk Access Load** test heavily loads the hard disk and disk-caching system. To do this, each station randomly accesses its own 100K data file using 1K records. Data written to the file is changed each time. The random reads typically access data outside the cache, which forces a disk read, as does any write.

spend a lot of time with it in your lap as you try to install and maintain this operating system. The concepts used in *Port* are a little further from DOS than other popular network operating systems. You have to stretch further.

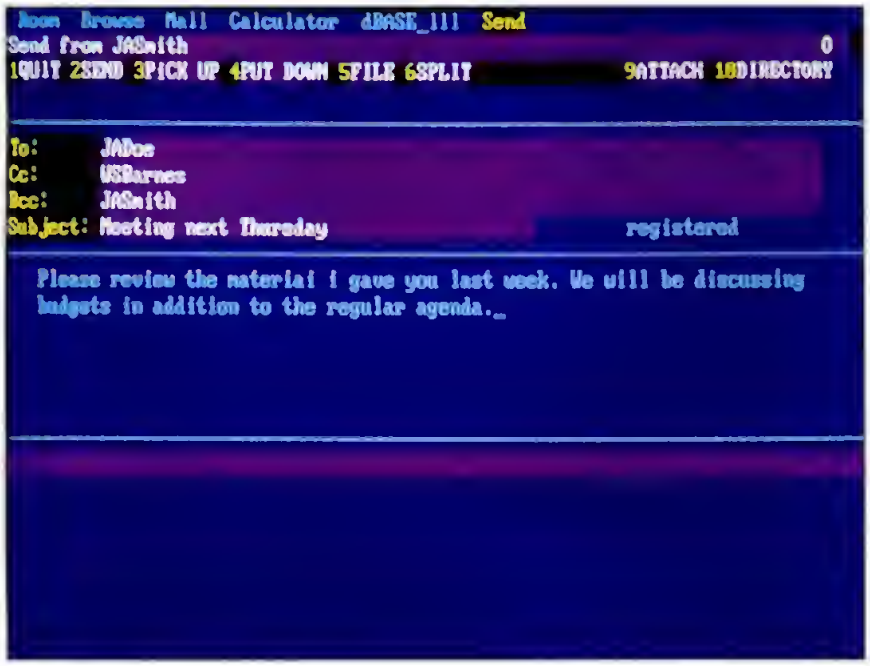
DOS users will not like the fact that *Port* is case-sensitive. You have to type user names and other command-line entries using the right combination of upper- and lowercase characters. *Port* file names use a forward slash instead of a backslash, but when you are in the DOS mode you can refer to them either way. The *Port* browser and editor are indispensable tools when installing *Port*, but if you have to learn to use new tools at the same time you are constructing a new operating system, the process goes slowly.

The *Port* installation program looks at the hard disk and describes the existing partitions. A command called MAKE does a track-by-track verification on the disk and formats it for *Port*. Combining the commands VERIFY and MAKE causes the operating system to do a complete surface analysis of the disk and to format it for *Port* operation. VERIFY reads and writes to every sector in the partition being verified and, if it finds bad areas, records them into the "bad block" file.

The installation process for *Port* consists of feeding the diskettes into the drive of the server in response to prompts appearing on the screen. The files are listed on the screen as they are copied.

Getting the operating system running requires reading the manual and carefully following the instructions. Installing the applications running under DOS (and therefore under *Port*) presents the real challenge. The icon library contains general-purpose icons you can use for your applications, but you must create the command file activated by the icon to run the application. The network administrator for a *Port* system needs training in the detailed process of installing applications. In fact, the need for a trained administrator is greater here than with any other network operating system we have evaluated.

Installing DOS on the network software server is a five-step process. First you need to create a DOS icon that will be used to start each DOS session. The program provides a kind of "draft" icon, but you need



Like most other network programs, Waterloo Port *features an electronic-mail facility that allows communication between workstations.*

to do a lot of reading to understand how to set it up to work. After the first installation, it is easy to use DOS and hotkey (Ctrl-Alt-PgUp) between DOS and the *Port* activity.

Next, the network administrator has to define the environment (including the DOS environment) for every user. The network administrator establishes a new user by selecting the user icon and typing the user's name. Each user ID creates a unique logical file space (like a DOS subdirectory) with that ID attached. The user or system administrator designates that file space as shared. The environment includes information on what icons will be displayed to the user, what access permissions (read, append, modify) apply, and even the personalized keyboard configuration for each user. The administrator or users can define keyboard macros, usable in both *Port* and DOS, that are automatically loaded into the workstation when the user signs on.

The administrator also builds a detailed profile for each workstation on the network; the profile includes the type of video display available and resources shared with the network. Any changes in hardware have to be recorded in this profile.

When the network is operational, the station and user profiles both control the resources contributed by and used by a workstation.

One "room" all users can access is the supply room. It contains useful icons like "colors," which allows you to change the colors on a CGA screen. The color, cursor size, and other features are attached to the user name. The "locked" icon freezes the workstation keyboard, so if you have started a process you can walk away without fearing that someone will try and use your station. All of these icons can be copied from the supply room and moved to any other room.

Since all of the stations on the network can contribute resources, including files, one station is referred to as the network software server (meaning that it handles the boot software) instead of a file server. Actually, you can have as many of these as you like, but there must be at least one in a network, and you must have one copy of the *Port* networking software per network software server. The network software server isn't dedicated to server functions; it can still be a file server, a print server, and a regular workstation.

In a typical network, the Port workstations boot from the network software server. A PROM on the network interface board redirects the boot sequence out through the network. If you press the F1 key to interrupt the boot, the workstation does a normal DOS boot from a floppy disk or a DOS partition on the hard disk.

If you are running from a computer booted as a DOS workstation, you can still access network resources through commands similar to those used by Microsoft MS-NET. These include NETUSE and NETSTAT. The *Port* command DCOPY copies entire volumes, including hidden files; PERMS lets you set permissions in a DOS subdirectory; and PORT COPY lets you copy files from DOS to the *Port* operating system.

Port's ability to boot from the network software server makes it a natural for use with the diskless workstations that are becoming popular because of their ergonomic and security advantages. If you want to use diskless PCs, you don't have to install boot ROMs and make an image of DOS on the server's hard disk, as you do with Novell, 3Com, and other systems. The network is already configured for diskless operation.

HARDWARE The Waterloo system we evaluated used the ARCnet networking hardware, a system that rated highly in our LAN benchmark tests (see "Making Connections: 13 LANs in Perspective," *PC Magazine*, April 28, 1987). It typically uses a coaxial cable wiring scheme with the cables arranged in a hub. Several different types of ARCnet hubs are available, including active devices that regenerate and repeat the messages originating from the network nodes.

Each network interface card in any ARCnet system must have a unique station address, which is used to decide which card generates the messages that give other cards permission to transmit. In contrast to ARCnet cards from Pure Data and Standard Microsystems that use switches, the addresses of the Port network interface cards are set through software. You use a menu-driven program to set the station addresses. Addresses of 200 and above are reserved for software servers and boot locally. Devices with addresses below 200

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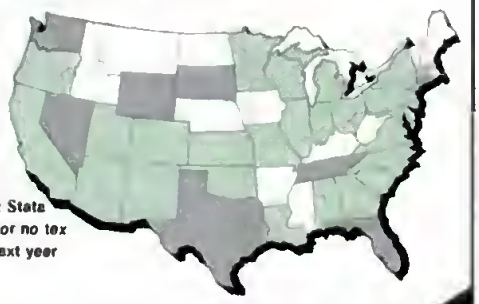

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■ WATERLOO PORT

boot from those with addresses above 200.

The Waterloo implementation of ARCnet is easy to install and provides the reliability of ARCnet's hub topology. The system does not include activity or continuity lights like those on the Pure Data implementation of ARCnet.

THE REAL PORT While the folks at Waterloo Microsystems are trying to become another Novell, we think they need a different track. Because of its significant differences from DOS and its complexity,

■ *Port* offers synchronized message passing between applications in a real-time environment.

we can't describe *Port* as a network operating system for the do-it-yourselfer. *Port* is best used by sophisticated programmers writing multitasking software for vertical applications. It has proven appeal in the academic environment, too.

For the system developer, *Port* offers synchronized message passing between applications in a real-time environment. This allows programmers to structure programs and tasks as a set of cooperative processes. A system developer can concentrate on higher-level code and leave the network processes to the operating system. When a file is opened, a process is created that monitors the state of a client by waiting to receive a message. The system developer doesn't have to write any special routines to monitor the stations on the network. The operating system will detect any change in condition.

Port has good flexibility and a friendly user interface. But with its complexity and relatively lackluster performance times, we think it needs to find a niche in vertical turnkey applications where the tasks of installing, updating, and maintaining the system are kept far from the user. PC

Frank J. Derfler, Jr., is a contributing editor of PC Magazine.

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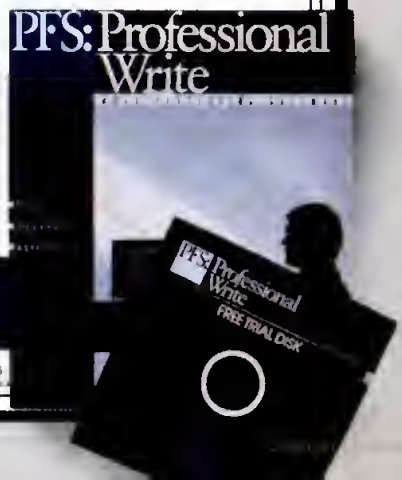

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■ ADD-IN BOARDS ■ WILLIAM TAYLOR

Just the Fax

Six new PC fax boards turn your computer into a worldwide communicator with high-quality text and graphics transmission abilities.

Sparks are flying from the exploding PC fax market. The six PC fax systems we review here are some of the latest entrants in this hot product category. For as little as $395, they can turn your PC into a fax machine and send your pictures and text around the world in minutes.

The arrival of competitive products such as these has introduced a new element in computing, releasing new power wherever PCs are used to create documents that contain both images and text: the power to send pages of words and graphics to any one of the world's approximately 2 million fax machines—within minutes and for only the cost of the phone call.

The technology that ignited the explosion is giving PCs the powers of facsimile, (fax) machines. It enables them to take documents created using PC software—including graphics, CAD, desktop publishing, spreadsheet, and word processing programs—and transmit the material over telephone lines to a facsimile machine or another fax-equipped PC. The receiving machine can then print out a facsimile, or copy, of the document.

The tools of the technology are PC fax boards—modem-like cards that generally slide into a slot in your PC and hook up to the telephone line and a telephone—plus the PC fax software that comes with the hardware and makes it work. The software usually includes conversion utilities that enable you to send pictures and text that originated in diverse, incompatible file formats. Added to PCs, these hardware/software systems offer the capabilities of conventional fax machines for a fraction of their cost.

Besides serving as stand-ins for conventional fax machines, PCs with fax capabilities can become full graphics communications systems, creating, managing, sending, receiving, storing, displaying, and printing complex picture-and-text documents. Desktop publishers with a global viewpoint can now circulate their communiqués to a vast international readership, quickly and without using a single sheet of paper.

A QUESTION OF QUALITY

I used to think the idea of PC fax cards was a crock. If you want to send a facsimile document, buy a fax machine. It's that simple. Now that we can buy nice, compact, affordable desktop Group 3 fax machines such as the low-end models from Ricoh and Canon that print on plain paper, why mess around with sending faxes from PCs to save a buck or two?

That was before I discovered what PC fax cards are all about: quality. And maybe convenience. Not economy.

Fax is a wonderful medium for exchanging documents when you need a picture of the document—including letterhead, signatures, possibly graphs and notary seals, and all the rest of it—and not just the text. If all you need is the text (and in potentially revisable form, at that), you want an electronic mail system such as MCI Mail, or simple direct PC-to-PC transfer—in both cases using modems and ordinary dial-up phone lines.

Unfortunately, the output quality of most fax machines ranges from mediocre to the other side of abysmal. While the current-standard Group 3 machines are in theory 200- by 200-dot-per-inch machines, often you couldn't tell it from their output. Most fax output looks like about 75 by 75 dpi at best.

And of course we still have a lot of fax machines that print on thermal or even wet-process paper: "Quick, Margie, make a Xerox of this before it fades! And maybe then we can read it!"

LOOKING GOOD PC fax, on the other hand, when it originates in a 300- by 300-dpi scanner on your end and emerges from a 300- by 300 laser printer at my end, looks sensational. The transmitted (and reproduced) image is still bounded by the 200 by 200 limits of the Group 3 standard, but that crisp laser output looks awfully good. It's a revelation to those accustomed to ugly, shiny, hard-to-read, low-resolution thermal-paper fax output.

So the quality of the transmitted document will likely become the reason most users look into PC fax. Convenience will close the deal for some—but only some. It's very nice to be able to scan and transmit a document quickly, in the background, while you're doing something else on your PC. But that has two strikes against it.

First is the pile of hardware you have to have to do that: PC plus scanner plus laser printer. Laser printers are becoming widespread corporate standards; they aren't the problem.

Granted, scanners are becoming common enough in desktop publishing setups, but they remain rare birds in general business settings. And well they might: what are people going to do with them? But effective use of PC fax requires a scanner: otherwise you're limited to sending only text documents (better handled another way, as stated above), and able only to receive documents that incorporate graphics.

It's hard to believe we'll soon see scanners occupying valuable desktop real estate next to very many PCs just to send fax documents. And remember that adding a scanner doubles or triples the cost of setting up for PC fax . . . which puts it perilously close to the cost of a "real" fax machine.

TAKE A FAX, MS. SMITH The second flaw in the argument that convenience is a big selling point in PC fax: human nature. In my experience, even today most originators of PC fax documents don't send them themselves: They have someone to do that for them. Indeed, most people I know who use fax very much haven't the slightest interest in or knowledge of how the process works: They hand a document to someone with instructions to "fax this to Bridget in L.A." And someone brings them

Fax technology holds the promise of even greater power. The current, digital fax transmission format is the accepted standard for telecommunicating graphics information. Its application in the PC market could herald the end of the chaos of incompatible file and storage formats. Also, because PC fax systems are both inexpensive and based on the fax standard, they could serve as the missing link between mainframe database systems and worldwide distribution channnels for graphics information.

TIME AND MONEY Until recently, if you needed to speed a drawing of an architectural plan or a product design to a geographically distant client, time wasn't on your side. Probably the fastest and cheapest solution was to use a courier company like Federal Express. If overnight delivery (and another night and day to have the document returned with changes or signature approval) was too slow, you were out of luck—unless you had access to a full-fledged fax machine, a $2,000 to $3,000 hardware investment.

But, with the advent of PC fax systems, you no longer need a four-figure hardware budget to take advantage of facsimile technology. With one of the six fax products we describe here, you can get into the fax world for as little as $395. All the PC fax products we reviewed let you send documents at the rate of less than a minute per page, and you don't even have to pay for paper.

With so many conventional fax machines around the world ready to receive graphics-and-text documents from PCs, it's no wonder that businesses, government agencies, universities, and other groups with global interests and connections are fueling the booming PC fax market. About half of these machines are installed in Japan, a major player in the world's markets. The Western business community is also contributing to the fax boom, sending pages of text and graphics that confirm contracts with signatures, newspaper and magazine layouts, plus

incoming faxes when and as they're received.

Frankly, if most of us send someone else down the hall to the fax machine now, we're unlikely to be easily persuaded it's a big deal to let that person fax things from his or her desk. Unless we send and receive a *lot* of faxes.

There's one last impediment to the rapid and widespread distribution of PC faxing throughout business: the perception that fax is a very expensive medium. It's laughable, but many who send important business letters by overnight courier at the drop of a hat shrink from spending "all that money" on faxing documents—although FedEx-ing a one-page document overnight costs about 20 times as much as faxing it immediately.

FAX-GOUGING Lots of little everyday reinforcements of that "fax is expensive" notion make it one of the tougher myths of business culture to shake off.

My seatmate on a recent airline flight was telling me about being charged $120 by his Newport Beach, California, hotel to receive a 24-page contract faxed to him by his Dallas office. That's about ten times the actual cost to the *sender* of transmitting the message, and maybe 100 times the actual cost to the hotel of receiving it. With markups like that, the outrageous 100- to 200-percent markups some hotels slap on dialed long-distance calls start to look cheap.

And what about charge-backs in your office? Do you still have to record, sign for, and later be billed for Xerox copies? Of course not. But I'll bet faxes are still treated that way in your firm. Take a look around or on a shelf near the fax machine: see that clipboard where you're supposed to record all the faxes you send? Because they're so expensive?

Indeed, a number of office managers recoil at the mere thought of widely distributed PC-faxing power: what an opportunity for the profligate to bankrupt the company!

So the road to turning PC fax into a big hit may be a long and difficult one. But as more and more people who are already regular fax users—and understand the economics of 50-cents-a-page instant document transmission—see PC-faxed documents, the quality issue will come to the fore.

And PC fax cards may become more common than, say, pen plotters, if still less than ubiquitous.—**Jim Seymour**

Jim Seymour is a contributing editor of PC Magazine.

such documents as drawings, maps, charts, and design plans.

THE EARLY DAYS The fax business got off the ground in the mid 1960s when the European standards committee known as CCITT Comité consultatif international téléphonique et télégraphique) developed a facsimile data transmission standard called Group 1. Machines based on the Group 1 standard could transmit a page in about 6 minutes. In 1976, Group 2 machines cut the transmission rate to 3 minutes.

The Group 3 standard, introduced in 1980, enables machines to transmit a page in 30 to 60 seconds at a resolution of 200 dots per inch (dpi) horizontally and 100 dpi vertically. Group 3 users can increase the resolution to 200 dpi vertically, which comes close to the print quality of early laser printers but roughly doubles transmission time.

Another standard, Group 4, was introduced in 1984. It requires high-speed dedicated lines, however, and machines based on this standard cannot operate as dial-up devices.

Group 1 was based on analog signal transmission technology, but Groups 2 and 3 both involve digital transmission. As digital technology has dropped in price and increased in speed, digital fax technology has improved to keep pace.

Group 3 is now the most popular standard: in less than 6 years, the Group 3 fax machine population has risen to half a million. PC fax systems unite the power of your PC with the power of Group 3 fax.

BEYOND THE TELEX PCs have long been used to transmit pages of text, as telex machines can. Graphics and documents that combine images and text have been another matter, their transmission hampered by incompatible file formats and the lack of an industry standard. That's why businesses were dependent on expensive facsimile machines and the slower alternative, express delivery services.

Yet sending images to someone else has always been possible via PC—if both the sender and the receiver have modem-equipped PCs running the same graphics and communications software. That's unlikely to be the case in most instances, especially in today's active global business and financial markets. It's more likely that the receiver will have access to a facsimile machine, and now, with the growth in the market, to a PC with fax powers.

PC fax systems work around the problem of file format incompatibilities among graphics, paint, CAD, and desktop publishing programs. The universal form of communication they rely on is the printed page. Like conventional facsimile machines, PCs with added-on fax capabilities combine certain characteristics of copiers and modems. A copier scans an input document and produces a copy locally. A fax machine scans input documents in the same way, but instead of making copies, it telephones another fax machine, as does a modem when transmitting text.

What's more, instead of transmitting text in digital bytes representing the alphabet the way a modem does, the fax-equipped PC transmits text and pictures in patterns of light and dark scanned from the original. The machine at the receiving end prints the data, and someone, no matter how far away from the sender, has a copy of the document within minutes. And sending a document by fax makes sense even if the recipient is nearby, since it can cost less than the stamp on a letter, to say nothing of the cost of the envelope and letterhead plus the follow-up call to make sure the letter arrived.

SEND AND RECEIVE Fax boards for PCs, like modems, have two telephone jacks on the back, one for a line out to the phone system and one for an actual telephone. The line connection lets the fax unit dial out to send documents and answer the phone to receive them. The telephone shares the line with the fax board; you can use it to make normal calls when you aren't using the PC as a fax machine.

All the products we examined can dial and transmit documents, receive documents unattended, and remember a list of documents to be transmitted at specific times—for example, at night when rates are low. They all have RAM-resident background utilities that wait for fax calls while you use your PC for other things. They can store received documents on disk in compressed fax format, and they can send the documents to a printer as well as display them on the screen.

In addition, all the fax systems maintain log files showing what they sent and received and when they did it. They can maintain a list of telephone numbers for you; some even have a built-in modem.

Other systems also offer built-in OCR (optical character recognition) and image-editing capabilities. Panasonic's Fax Partner is the only product reviewed here that includes a built-in image editor.

YOUR ROLE Like conventional fax machines, PC fax systems are easy to use. In fact, once they're set up and installed, even users with limited PC experience find them almost as easy to operate as a telephone.

In order to work with your PC, most fax boards require you to set a series of DIP switches to configure the system according to your needs and the other options installed in your PC. If you set a switch incorrectly, your PC may refuse to boot up after you install the fax board, or the fax system may fail to work.

One fax board figures out how to get along with its neighbors without your help. This considerate, switchless board appeared as Electronic Information Technology's pc-Fax in our reviews last year (PCs and Fax Get It Together," *PC Magazine*, June 23, 1987); the same board shows up here as Communication Technology's Executive Fax. All manufacturers should follow the example of this board's enlightened designers and eliminate the need to set DIP switches.

With the tiresome process of setting DIP switches behind you, you can hook up the board and connect the telephone line and telephone quickly and easily. Installing the fax software goes smoothly for the most part, facilitated by menu choices and prompts. Then you're ready to transmit word and pictures by long distance.

WHAT, WHERE, WHEN To send a document by fax transmission, you need to tell the system what data to fax, where to send it, and when to send it. Where and when are easy. *Where* is the telephone number of the receiving fax machine or fax-equipped PC; you simply type it onto the screen or select it from the program's telephone directory file. *When* is the date and time, also entered through the keyboard. The difficult part is *what* to send.

To transmit a picture, a fax system sends signals representing a line of pixels on a page to the receiving fax-equipped PC or fax machine. Each pixel is "on" or "off," and successive lines of these dots make a pattern on the page, just like the dots on the PC's screen.

Because all PC fax systems must conform to the standards established by facsimile technology, they all send pixels essentially the same way. The differences lie in where they get the dots—from image scanner output, conversion utility files, screen display, printer-intended files, application program files, or files from a built-in graphics editor.

SOFTWARE IS KEY The software that supports PC fax boards is what determines where and how the systems get the signals they transmit, and it's what differs the most from system to system. One common feature of the programs reviewed here is a menu-based user interface. They diverge in their ability to handle the various incompatible file formats of PC graphics software.

With the exception of Smartfax, all the PC fax systems we reviewed can accept files containing images generated by *PC Paintbrush*, and some can handle graphics images in other file formats as well, including .TIF and .PIC formats. The problem is that PC fax systems cannot handle all file formats; they cannot read CAD files or *Lotus 1-2-3* files or most word processor files, for example, in the original formats. These files must be converted into a format the fax software can read.

Besides transmitting graphics, all the fax systems we reviewed can convert text files in ASCII format to facsimile format for transmission. Their ASCII conversion utilities read lines of characters, converting each character into a set of dots that looks like the character. You can also use this method, called scan conversion, to send a *1-2-3* spreadsheet that's been printed to an ASCII file.

TRAFFIC JAMS The RAM-resident routines that these six systems use to receive incoming fax documents in the background while you continue with other PC tasks can conflict with other RAM-resident utilities you may be using. Since Panasonic's FX-BM88/89 Fax Partner has its own microprocessor and RAM, it's well equipped to handle incoming fax documents without disturbing your PC's ongoing activities. The other systems rely on the PC to carry the burden; hence your other applications may slow down or even stop when the machine receives a fax document.

Another potential problem is that, like modems, PC fax boards generate radio interference. The vendors of the units we reviewed have tested their equipment to make sure that any radio noise generated does not exceed the limit set by Federal Communications Commission regulations. But if you encounter a problem with interference, take Panasonic's advice and consult the Government Printing Office booklet, "How to Resolve Radio-TV Interference Problems."

CHOOSING A FAX PRODUCT What makes one fax system better than another is primarily the software's ability to convert files from various formats into the standard fax format for transmission. All the systems can convert and send ASCII files in minutes to fax equipment anywhere in the world, but not all of them will be able to handle files generated using your application programs. The formats that a PC fax system can accommodate and the

way it prepares, displays, edits, receives, and stores documents are the most important factors to consider when you're making a purchase decision.

Six more PC fax systems have joined the market since we predicted the imminent PC fax explosion and reviewed seven fax systems for PCs last June ("PCs and Fax Get It Together," *PC Magazine*, June 23, 1987). The new systems, made by Asher Technologies, Brooktrout Technology, Communication Technology Co., Datacopy Corp., Panasonic, and Strongline, attest to the booming PC fax market.

ASHER TECHNOLOGIES

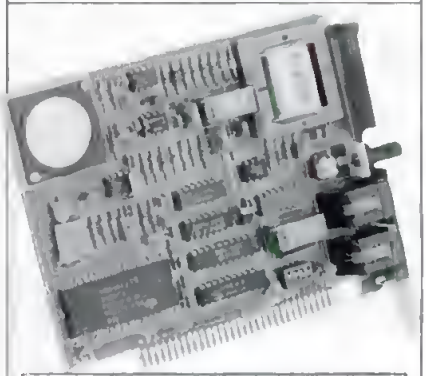
JT-Fax

Asher Technologies' $395 JT-Fax is a nifty little fax system that not only costs less than the others but also operates differently. Other fax systems convert files from ASCII format, screen capture format, and other formats into fax files before they call the receiving fax unit. JT-Fax waits until it can make the call and figure out how the receiving unit will actually print the document, then converts on the fly while transmitting.

In-flight conversion is possible because JT-Fax transmits at a maximum of 4,800

EDITOR'S CHOICE

FACT FILE



JT-Fax
Asher Technologies
1009-I Mansell Rd.
Roswell, GA 30076
(800) 334-9339
(404) 564-2353
List Price: $395
Requires: 190K RAM, one half-size 8-bit slot, hard disk recommended; graphics card required to view fax documents but not to run the software.
In Short: This neat little fax unit goes its own way, converting documents on the fly while transmitting them at half the speed of the other units. Its unusual approach keeps its cost down and saves file storage space, making it ideal for many users.

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bits per second instead of the 9,600 bps of other units. The PC is not fast enough to convert files on the fly while transmitting at 9,600 bps.

MONEY SAVER The slower transmission speed is what enables Asher Technologies to offer JT-Fax at such a low price. According to many vendors, most of the cost of fax hardware is in the 9,600-bps modem chip.

The system's transmission speed shouldn't really be a problem unless you send a lot of fax documents. It would take a great many messages to justify the extra $600 you'd have to pay for a faster unit, especially considering that the sender pays for the calls when you receive documents.

SPACE SAVER Asher Technologies claims that converting a document according to how the receiver will print it produces better-looking documents. Deferring the conversion of the files also saves disk space. Fax files are big: an 8½- by 11-inch page, for example, scanned at 200 dpi, requires almost half a million bytes of storage. Data compression usually reduces this amount by about an order of magnitude, but documents in fax format take up a lot of room even when reduced to 50,000 bytes per page. JT-Fax eliminates this problem.

JT-Fax lets you specify a number of files to be linked together and transmitted as a single document. You can thus build one document from separate letterhead, ASCII text, and signature documents, for instance. The system will accept files from *PC Paintbrush*.

The only problem with mixing text and graphics documents and sending them as if they were one document is pagination. Your word processor has no idea that a line beginning with the command *SIG:filename—which tells JT-Fax to transmit a file containing the image of your signature—takes up more than one line on the page. Consequently the page endings are thrown off.

The pagination problem is easy to forgive, though, since many fax machines receive documents on continuous, unperforated paper and do not limit page length. Most fax vendors have ignored the pagination problem, but Asher could contribute to the technology by addressing the issue. The documentation could also be improved by the addition of at least one illustration depicting the board's installation and setup.

Another minor complaint: Although the menus offer you the option of displaying a disk directory, JT-Fax takes the directory away before letting you enter a filename. A more convenient arrangement would be to let you select a file from the directory display. A more serious complaint: JT-Fax uses DIP switches to set memory

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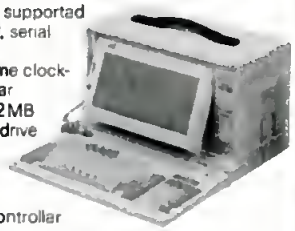

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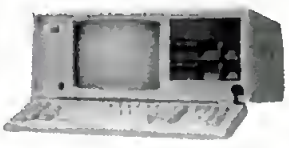

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addresses instead of allowing you to configure them through software.

Even though it transmits documents at half the speed of other fax boards, JT-Fax is ideal for use at home or in a small business. Its price is especially attractive.

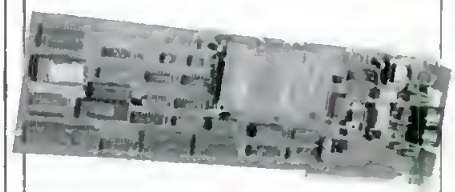
BROOKTROUT TECHNOLOGY

Fax-Mail 96

Fax-Mail 96, a $995 fax board from Brooktrout Technology, is the newest product reviewed here. It is the top-of-the-line board among Brooktrout's three Fax-Mail models, which transmit Group 3 format documents at 2,400, 4,800, and 9,600 bits per second, respectively.

The vendor offers utilities to convert files to and from *PC Paintbrush* format or Fax-Mail's format. Another valuable Brooktrout utility intercepts Epson printer commands and turns the data that would have gone to the printer into a fax file. The documentation includes command sequences that you can use to generate AS-CII files from *MultiMate*, *Microsoft Word*, *WordStar*, and *Lotus 1-2-3* files.

PC MAGAZINE FACT FILE



***Fax-Mail 96*, Version 1.0**
Brooktrout Technology
110 Cedar St.
Wellesley Hills, MA 02181
(617) 235-3026
List Price: $995
Requires: 640K RAM, hard disk, full-length 8-bit slot; graphics card required to view fax documents but not to run the software.
In Short: On the market only since July 1987, this fax product is competent but no threat to the competition. It lacks a really flexible file converter, but you can transmit any files created by software that also offers support for Epson printers.

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EPSON FORMAT Using the printer-interception utility, Fax-Mail 96 can fax anything created by any software package that can send files to an Epson-compatible printer, no matter what the file format: graphs, CAD Drawings, database forms, and so forth. As long as your software drives an Epson-compatible printer, you can turn the output into fax format.

Although the Fax-Mail 96 documentation acknowledges that many users will experience trepidation when opening their computer cover for the first time, it lacks even one picture to illustrate how to install the unit. Although the installation instructions are complete, a few diagrams would help considerably.

Fax-Mail 96 works reasonably well, but it fails to outshine the more full-featured and flexible PC fax systems on the market.

COMMUNICATION TECHNOLOGY CO.

Executive Fax

Executive Fax, a $1,095 hardware and software unit from Communication Technology Co., is a clone of pc-Fax (reviewed in *PC Magazine*, June 23, 1987). Its hardware deserves credit for taking a lot of work out of your hands, saving you both time and aggravation. Unfortunately, the uncommunicative software sabotages some of the unit's convenient features.

NO SWITCHES On the plus side, instead of using switches that you must set to specify a memory address, Executive Fax automatically looks through the available addresses to find one that is not being used. Instead of asking you to make decisions, it figures things out for itself. In addition, Executive Fax is the only fax unit we reviewed with labels for the telephone plugs, rescuing you from having to consult the manual to figure out the correct socket for the telephone.

Yet the convenience that Executive Fax's hardware gives, its software takes away. You have to put each recipient's number in its telephone book before you can transmit—it won't let you simply type in a number for a one-shot transmission. You must also move all pictures to the Executive Fax directory before you can send them—you can't simply change to the disk directory where the pictures are stored.

During the installation procedure, the software prompts you for the size of the fax buffer, but it fails to give you even a hint of what the buffer is for. If you set it too small, the unit will transmit only part of your pictures. If you seek help from the vendors, they will tell you to make the buffer bigger. An error message like "Insufficient memory for buffer" would help. However, an even more annoying, and possibly destructive circumstance occurred: When we set the buffer too low (causing the unit to send truncated rather than full pictures), the activity log reported that Executive Fax had sent the pictures without any problem.

■ Executive Fax has some valuable features, including the ability to merge images into word processor files and generate fax files for transmission.

Executive Fax is consistently uncommunicative. When we tried to send a file that was in the wrong format, the unit made the call first and then looked at the file and decided not to send it. Again, no message alerted us to the problem. And though the Executive Fax software does include some conversion utility files, the documentation makes no mention of them.

The system uses the utility programs to convert *PC Paintbursh* files for transmission.

MERGING IMAGES On the other hand, Executive Fax has some valuable features, including the ability to merge images into word processor files. To do this, you insert commands specifying the corners of each image and the source file of the images. The software then merges the pictures with your document and generates a fax file.

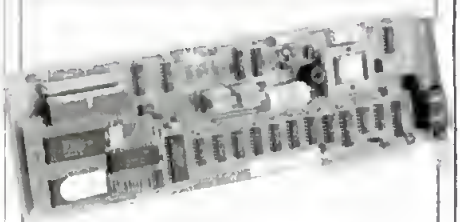
For example, the command *\1 LOGO.F01 places the upper-left-hand corner of the picture in file LOGO.F01 at the point where the asterisk (*) is located in the document. The command 1/* indicates the placement of the picture's lower-right-hand corner. You have to allocate enough vertical space between the *\ command and the /* command to hold the picture, so that your word processor can account for the required space and can paginate the document correctly.

You can overlap pictures by starting a picture before ending the previous one. The overlapping image can either hide the one below or let it show through, depending on the imaging command. All text in the picture area shows through. Executive Fax also enables you to preview the files on the screen before sending them. The system thus comes pretty close to giving you full desktop publishing capabilities.

Although the unit's software should do a better job of keeping you informed by issuing error messages and reassuring feedback, the hardware is a dream. With the

EDITOR'S CHOICE

PC MAGAZINE FACT FILE



Executive Fax
Communication Technology Co.
19925 Stevens Creek Blvd.
Cupertino, CA 95014
(408) 973-7816
List Price: $1,095
Requires: 640K RAM, hard disk, one standard 8-bit slot, graphics adapter, DOS 3.0 or later.
In Short: This unit, the most convenient fax product we reviewed, has no address switches to set. It offers all the features most users would need.

CIRCLE **647** ON READER SERVICE CARD

hardware's convenient features and the package's overall capabilities, the credits outweigh the debits: Executive Fax is a well-functioning, capable package.

DATACOPY CORP.

Microfax

The $1,195 price of Microfax reflects its capabilities. It's a pro at handling complicated documents.

Datacopy was an early player in the desktop publishing arena. Its WIPS (Word Image Processing System) was one of the pioneers in mixing text and graphics on the screen. As desktop publishing programs multiplied, Datacopy worked with Aldus, Microsoft, and other companies to standardize file formats so that its fax unit could transmit documents produced by most publishing systems. The result of this effort was the .TIF (Tagged Image File) format.

The .TIF file format enables the application programs that support the format to tag their private information in order to keep it separate from image data. Other programs that use files in the .TIF format can thus ignore the tagged information.

Any program that supports files with the .TIF extension can find the image data because the picture is stored in a known place in the Group 3 compressed-fax format. Many PC desktop publishing programs support .TIF files, and the format is popular in the Macintosh world as well.

■ Datacopy reduces the cost of setting up a fax operation by including a built-in Hayes-compatible modem with its Microfax board.

FILE-HANDLING PRO The payoff of Microfax's ability to handle .TIF files is that the system can take such files, produced by page layout programs, and transmit them to any fax unit. The distant fax machine becomes a remote printer for a document preparation system.

In addition, Microfax's own .IMG file format is becoming something of a standard for pictures. *AutoCAD*, for example, can produce .IMG drawings, which Microfax can then transmit. Since these drawings can have resolutions as high as 200 dpi, they often look better than drawings produced by pen plotters.

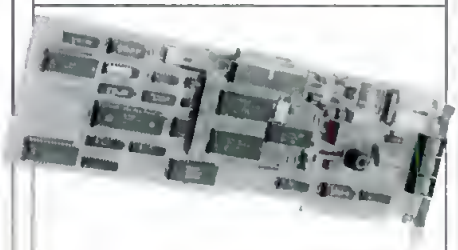
The Microfax software includes an image-to-image file conversion utility called I2I. To use this easy, helpful feature, specify the input and output files. I2I then takes over, figuring out the format you want from the file extensions.

BUILT-IN MODEM Fax boards generally contain nearly all the components of a conventional modem, but Microfax gives you 100 percent—by including a built-in Hayes-compatible modem with its fax board. This added feature in effect reduces the cost of the fax board for those users who would also need to buy a modem.

The documentation includes clear illustrations showing how to install the board. They're good enough to use when installing any add-in board, so you'll want to hang onto them.

Microfax is a highly capable fax unit, with a fairly high price to match. Its built-in modem is an added bonus. If you need to transmit highly formatted documents, Microfax's professional file-handling capabilities—especially its support for .TIF files—make it worth the price.

PC MAGAZINE FACT FILE



***Microfax*, Version 1.1**
Datacopy Corp.
1215 Terra Bella Ave
Mountain View, CA 94043
(800) 821-2898
(415) 965-7900
List Price: $1,195
Requires: 384K RAM, hard disk, one standard 8-bit slot; graphics card required to view fax documents but not to run the software.
In Short: With the added value of a built-in modem and the capability to handle highly formatted documents from .TIF files, this capable fax system justifies its higher price. Its file conversion utility is the best we've seen.

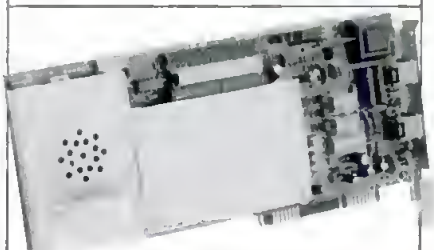
CIRCLE 648 ON READER SERVICE CARD

PANASONIC

FX-BM88/89 Fax Partner

Since Panasonic has long been in the market for conventional facsimile machines, it's no surprise that the company now offers the FX-BM88/89 Fax Partner, a $999 fax board for the PC. The Fax Partner was designed primarily to be easy to use, and it is—especially for transmitting word processing documents.

PC MAGAZINE FACT FILE



FX-BM88/89 Fax Partner
Panasonic
Division of Matsushita Electric
Corp. of America
2 Panasonic Way
Secaucus, NJ 07094
(800) 447-4700
List Price: $999
Requires: 640K RAM, one standard 8-bit slot, 10MB hard disk, graphics card. Mouse recommended
In Short: This full-featured fax board excels at sending text. Despite the built-in graphics editor and version of *PC Paintbrush*, it's less adept at transmitting graphics.

CIRCLE 646 ON READER SERVICE CARD

The Fax Partner board is built around the 8081 microprocessor and has its own 256K memory on the board. Fax Partner thus relieves the PC of some of the processing burden it undergoes when the fax board is receiving documents in the background.

PC MAGAZINE EDITOR'S CHOICE

- **Executive Fax**
- **JT-Fax**

The best bet for small businesses and individuals is Asher Technologies' JT-Fax. It's simple to use, works well, and best of all is easy on the budget.

An innovative approach is the key to the success of JT-Fax: it converts documents on the fly while transmitting them at half the speed of the other units. This approach keeps its cost down and saves file storage space, without degrading image quality and without delaying typical transmission times appreciably.

Corporate buyers and MIS managers, though, may quake at the thought of hundreds of people setting switches wrong or the prospect of using a system that runs at less than maximum speed. For them the best choice is Executive Fax, from Communication Technology Co. It has all the features most users need, with no switches to set, and it can transmit at 9,600 bits per second as well.

Datacopy's Microfax, thanks to its excellent file conversion utility, also deserves recognition. Actually, the ideal PC fax setup for corporations is a combination of products: the Microfax conversion utility used with the Executive Fax system. Although you won't find that combination offered by any vendors, maybe you can play "Let's Make a Deal" with Datacopy and win the utility program.

LETTER PERFECT Panasonic's market researchers found that about 90 percent of all PC documents transmitted are one- or two-page letters generated by word processors; hence the company's product designers and developers gave the Fax Partner simple, flexible features for transmitting word processing documents. The fax board doesn't handle complicated graphics with the same skill as some other fax units, but it's unbeatable at transmitting letters quickly and easily.

Since Fax Partner's specialty is transmitting letters, it restricts you to sending ASCII files and graphics files read by its own graphics editor, including those in the .PCX and .PCC formats. The graphics editor—the focus of most of the well-illustrated documentation—is similar to the one in *PC Paintbrush*. Panasonic even supplies a version of *PC Paintbrush* with the system's software.

■ Fax Partner's graphics editor can read .PIC files created by application programs like *Lotus 1-2-3*. You can edit and massage a .PIC file before transmitting it.

The graphics editor can read graphics .PIC files that applications like *Lotus 1-2-3* create. Once you read a .PIC file into the editor, you can massage it until you're satisfied and then write it out as a fax file to send to its destination. More conversion utilities would be a welcome addition, enabling you to send files created in other formats.

GRAPHIC LIMITS Fax Partner did a poor job of transmitting the *AutoCAD* nozzle drawing used in our tests. Not only did the characters look less than crisp, but a line was missing in the transmitted document.

Another limitation is that you must move all the documents you want to send into one directory before you start to send them, since you can't change the disk directory from the menus.

FLASHING LIGHTS The Fax Partner's lights flash when you're sending or receiving a picture. Although this type of feedback is useful, the lights are located in a separate box that fastens magnetically to your PC's case and attaches to the fax board by a plug-in cable. At least the documentation warns you against putting the light box down on your desk, where its magnets could erase your floppy disks.

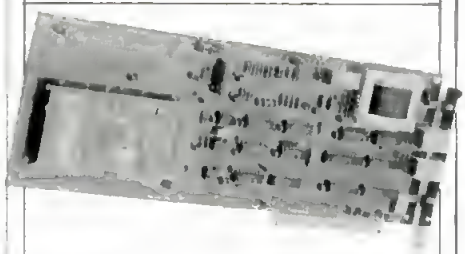
The bottom line is that Panasonic's Fax Partner is unbeatable for faxing letters, memos, and other text documents, but it's weak on graphics transmission.

STRONGLINE INC.

Smartfax

Smartfax, a $995 fax board from Strongline, requires you to set more switches than any other fax unit we reviewed. While the documentation says that the fax board has

PC MAGAZINE FACT FILE



Smartfax
Strongline Inc.
2465 E. Bayshore
Palo Alto, CA 94303
(415) 493-0457
List Price: $995
Requires: 384K RAM, hard disk, one standard 8-bit slot, graphics card.
In Short: Outclassed by the other PC fax boards, this unit requires more hardware settings than any of the others and gives you less software support; it even lacks support for *PC Paintbrush*.

CIRCLE **645** ON READER SERVICE CARD

■ The Smartfax software requests the time and date when you ask it to transmit. The current date and time according to DOS are the default entries, though.

21 switches, the board we tested had 17. Whether 17 or 21, the switches you're required to set are too many.

In fact, hardware settings control more board functions than in other units. For example, the choice between pulse dialing or tone dialing is a software selection for all the other boards; with Smartfax, making the choice requires manipulating the hardware.

When it comes to setting the memory address, the documentation, which reads as if a non-English speaker wrote or translated it, offers little help. You set the address with jumpers instead of switches. Since the illustration of the jumpers is hand drawn, it's difficult to figure out how to turn them on and off. Other hand-drawn elements in the documentation include the cursor keys; apparently the printer that produced the guide had no arrows in its character set.

SOFTWARE QUIRKS Instead of taking DOS's word, the Smartfax software requests the date and the time when you ask it to transmit. The current date and time according to DOS are the default entries, though, and you can bypass the requests by pressing Enter twice.

One handy feature unique to Smartfax is a built-in table of international dialing codes. It lists area codes for major world cities and for U.S. states and cities.

NO PAINTBRUSH Unlike the other fax units, Smartfax offers no support for *PC Paintbrush*. It would not transmit the *AutoCAD* nozzle used in our tests, but it does accept files from *Dr. Halo*.

Smartfax transmits documents adequately. But with too many switches, poor documentation, and a high price, it lacks market smarts. Considering Smartfax's heavy reliance on hardware settings and its lack of support for *PC Paintbrush*, all the other fax boards we reviewed outclass it.

William Taylor is a consultant on artificial intelligence in New Hampton, New Hampshire.

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CIRCLE 366 ON READER SERVICE CARD

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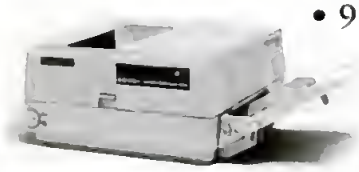
- Available now, for immediate delivery



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LaserJet is a trademark of Hewlett-Packard.

"The Destiny is one of the Laser Jet's strongest competitors."
—InfoWorld 10/5/87

"The Laser Act I's ability to print graphics 20% faster than does the HP Laser Jet plus speaks well for the machine and its manufacturer."
—PC Magazine 11/10/87

DESTINY

Destiny Technology
1012 Stewart Drive
Sunnyvale, Ca. 94086
Tel: (408) 733-3171

CIRCLE 747 ON READER SERVICE CARD

■ PC LAB NOTES: TP4 REVISIONS ■ NEIL J. RUBENKING

TURBO PASCAL 4.0: MAKING THE BIG MOVE

Turbo Pascal programmers will welcome the new features of Version 4.0, but some of the changes may mean making major revisions to your existing programs.

The good news is that Borland's latest version of Turbo Pascal includes the features most Pascal programmers have had at the top of their wish list. We've all wanted separate compilation of Units, new data types, "smart linking," and *no* 64K barrier. These and other important features are discussed in more detail in the sidebar "What's New in TP4?" The bad news is that since Version 4.0 involves a number of fundamental changes, you may have to do some major rewriting of your programs. In this issue of PC Lab Notes, I'll describe some of these problem topics and offer solutions.

Several problem areas arise from the change from .COM file output to .EXE files. Turbo Pascal 3 (TP3 hereafter) compiles directly to .COM files. This is part of the reason for its speedy compilation, but it's also the cause of the 64K barrier. A .COM file can have only a single code segment, and a segment can be only 64K in length. The new TP4 compiler produces .EXE files, in which every Unit can have its own code segment. But techniques that assumed a single code segment will no longer work as they did. Interrupt Service Routines (ISRs), INLINE code in general, and programs with overlays will all need revision. You'll also have to rewrite any code that took advantage of User Written I/O drivers or User Written Error Handler routines. TP4 retains these user-written items but expands them considerably.

INTERRUPT SERVICE ROUTINES

The .COM file limitation of TP3 eased the task of writing ISRs in several ways. An ISR doesn't have access to the data segment of the program in which it's imbedded, but in a .COM file its code segment is the same as that of the whole program. Since typed constants reside in the code segment in TP3, it's very simple to let the ISR communicate with the main program using typed constants.

This communication is especially important when you want your ISR to pass control to the old interrupt routine, i.e., use an interrupt chain. In TP3, you store the old interrupt's address in a typed constant. When you're ready to chain, you simply clean up the stack and JUMP directly to that address.

In a TP4 .EXE file, on the other hand, there is more than one code segment, and typed constants reside in the data segment. Thus, you can't use the same techniques. Borland does provide the Interrupt Procedure, a special kind of procedure declared as shown in Figure 1. A procedure declared in this way automatically saves and restores all the registers and makes the main program's data segment active. Figure 2 shows the code generated by such a procedure. If your ISR presently uses INLINE code, however, you'll have to remove any CS: overrides that precede references to typed constants.

Since an Interrupt Procedure automatically pushes the registers on entry and pops them on exit, you may wonder how you can pass any information out. The heading for an Interrupt Procedure gives a clue. The registers appear as if they were arguments to the procedure, and you access them as such. If you're writing Pascal code, simply refer to them directly. In INLINE code, refer to them as offsets from BP. Figure 3 shows a replacement for interrupt 16h (unenhanced PC BIOS) written almost entirely in Turbo Pascal. This is the

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```
PROCEDURE foo(_Flags, _CS, _IP, _AX, _BX, _CX, _DX, _SI, _DI, _DS, _ES,
_BP:Word);INTERRUPT;
```

Figure 1: *TP4-generated heading for an Interrupt Procedure.*

```
50              PUSH    AX
53              PUSH    BX
51              PUSH    CX
52              PUSH    DX
56              PUSH    SI
57              PUSH    DI
1E              PUSH    DS
06              PUSH    ES
55              PUSH    BP
89E5            MOV     BP,SP
81ECxxxx        SUB     SP,LocalSize
B8yyyy          MOV     AX,SEG DATA
8ED8            MOV     DS,AX
{Body of procedure goes here}
89EC            MOV     SP,BP
5D              POP     BP
07              POP     ES
1F              POP     DS
5F              POP     DI
5E              POP     SI
5A              POP     DX
59              POP     CX
5B              POP     BX
58              POP     AX
CF              IRET
```

Figure 2: *Special prelude and postlude code created by TP4 for an Interrupt Procedure.*

software keyboard interrupt, the one your programs use to get keystrokes from the keyboard buffer. Note the assignments to _Flags and _AX.

There's one major problem with the new Interrupt Procedure, however. Suppose you want to chain to the previous interrupt. You store the old interrupt vector in a variable of the new "generic pointer" type. Before you can JUMP to the old interrupt, though, you have to restore the original values of the registers from the stack, and that includes the DS register. And since you don't have access to the main program's data segment, you can't find the address of the old interrupt.

The program shown in Figure 4 shows a clever way around this dilemma, devised by INLINE wizard Lane Ferris. Normally, to get ready for the routine's end, we have to pop everything off the stack. To chain to the old interrupt, we play some tricks with the stack. AX and BX would be the last registers to get popped. We put the old interrupt vector into AX:BX, then exchange them with the segment and offset of the return address on the stack. When we pop the stack, we leave AX and BX on. As a result, when we do a RETF, control passes to the old interrupt, and when it ends, control goes back to the proper return address. You should be aware that this process may be version-specific, for future versions of Turbo Pascal may not store the return address at offsets BP+16 and BP+14. But for now it works, and it allows you to convert your ISRs to the new version.

INLINE CODE With TP4, you can no longer refer to the current location counter in INLINE code, nor can you directly call procedures and functions. It's not difficult to call a procedure in INLINE, though, as Figure 5 demonstrates. You just have to rewrite any INLINE code that assumes that typed constants reside in the code segment, or that manipulates the stack.

In return for undertaking this minor rewriting, you get a new kind of INLINE. TP4's new INLINE directives are similar to macros in a macro assembler. When you use the procedure name in your program,

```
PROGRAM New_I16;
  Uses crt, doe, hexx;
  (*The hexx Unit is described elsewhere in this article*)
VAR
  Kbd_Vec, Exit_Vec : pointer;
CONST
  Kbd_Int = $16;

  {$F+} PROCEDURE My_Exit;   {$F-}
  BEGIN
    SetIntVec(Kbd_Int, Kbd_vec); {restore OLD INT16}
    IF (ExitCode <> 0) OR (ErrorAddr <> NIL) THEN
      BEGIN
        Assign(Output, '');
        Rewrite(Output);
        WriteLn(^G);
        IF ExitCode = $FF THEN
          WriteLn('USER BREAK')
        ELSE
          BEGIN
            Write('Critical Error # ', HEX(ExitCode));
            Write(' AT PROGRAM LOCATION ');
            WriteLn(Hex(Seg(ErrorAddr^)), ':', Hex(Ofs(ErrorAddr^)));
          END;
      END;
    ExitProc := Exit_Vec;      {restore previous ExitProc}
  END;


  PROCEDURE CLI; INLINE($FA); {INLINE procedures are NICE!}
  PROCEDURE STI; INLINE($FB);
  PROCEDURE NOP; INLINE($90);

  PROCEDURE INT16_ISR(_Flags, _CS, _IP, _AX, _BX, _CX, _DX,
                      _SI, _DI, _DS, _ES, _BP : word);
    INTERRUPT;
  (*THIS procedure simply duplicates the function of (un-enhanced BIOS)
    INT 16h.  But it does it totally using Turbo Pascal!*)
  CONST
    Zero_Flag = $40;
    KIOS_Data = $40;
  VAR
    Buffer_Head  : Integer ABSOLUTE KIOS_Data : $001A;
    Buffer_Tail  : Integer ABSOLUTE KIOS_Data : $001C;
    Buffer_Start : Integer ABSOLUTE KIOS_Data : $0080;
    Buffer_End   : Integer ABSOLUTE BIOS_Data : $0082;
    KB_Flag      : Byte ABSOLUTE KIOS_Data : $0017;
  BEGIN
    STI;
    CASE Hi(_AX) OF
      0 : BEGIN          (*Need key (wait for it)*)
            REPEAT
              STI; NOP; CLI;
            UNTIL Buffer_Head <> Buffer_Tail;
            _AX := MemW[KIOS_Data : Buffer_Head];
            INC(Buffer_Head, 2);
            IF Buffer_Head > Buffer_End THEN
              Buffer_Head := Buffer_Start;
            STI;
          END;
      1 : BEGIN          (* Was a key pressed?*)
            CLI;
            IF Buffer_Head = Buffer_Tail THEN
              _Flags := _Flags OR Zero_Flag
            ELSE
              BEGIN
                _Flags := _Flags AND NOT(Zero_Flag);
                _AX := MemW[KIOS_Data:Buffer_Head];
              END;
            STI;
          END;
      2 : _AX := KB_Flag; (*Return shift states*)
    END;
  END;

  PROCEDURE Do_Demo;
  VAR
    CH : Char;
    L : STRING[255];
```

(continues)

Figure 3: *An Interrupt Procedure that replaces interrupt 16h.*

```
  I : Ioteger;
BEGIS
  WriteLn('Replacement keyboard ioterrupt is installed.');
  Write('PRESS eny key to continue....');
  REPEAT UNTIL ReyPressed;
  CS := ReadKey;
  WriteLn(CS);
  Write('Enter your name: ');
  ReadLn(L);
  WriteLn('Si, ', L);
  Write('Enter an ioteger: ');
  ReadLn(I);
  WriteLn('You entered ', I);
  END;

BEGIS
  ClrScr;
  CheckBreak := True;
  GetIotVec(Kbd_Int, Kbd_Vec);    {seve "old" INT16}
  SetIntVec(Kbd_Int, @INT16_ISR); {install new}
  Exit_Vec := ExitProc;           {eeve old ExitProc}
  KxitProc := @My_Exit;           {instell new}
  Do_Demo;                        {show yer stuff!}
  (The interrupt gete reetored io the ExitProc)
END.
```

(Figure 3 ends)

```
PROGRAM Shift_Rey_Freeeed;
  Uses crt, doe, hexx;
  (*The hexx Unit is described elsewhere in this article*)
VAR
  Kbd_Vec, Exit_vec : poioter;
CONST
  Kbd_Iot = 9;
  (* Scan codes for seven ehift keye *)
  SC_LeftShift  = 42;
  SC_RightShift = 54;
  SC_CtrlShift  = 29;
  SC_AltShift   = 56;
  SC_SumLock    = 69;
  SC_ScrollLock = 78;
  SC_CapsLock   = 58;
  SKF : Sooleen = Felee;
  which : Syte  = 0;

  {$F+} PROCEDURE My_Exit;   {$F-}
  SKGIS
    SetIntVec(Kbd_Int, Kbd_vec); (reetore OLD INT9)
    IP (ExitCode <> 0) OR (ErrorAddr <> NIL) TSEN
      SEGIN
        Assign(Output, '');
        Rewrite(Output);
        WriteLn(07);
        IF ExitCode = $FF TSEN
          WriteLn('USER SREAK')
        ELSE
          SEGIN
            Write('Criticel Error 0 ', SEX(ExitCode));
            Write(' AT PROGRAM LOCATION ');
            WriteLn(Hex(Seg(ErrorAddr^)), ':', Sex(Ofe(KrrorAddr^)));
          END;
      END;
    ExitProc := Exit_Vec;      {rsstore previous ExitProc}
  END;

  PROCEDURE CLI; INLINE($PA); {INLINE procedures are handy!}
  PROCKDURE STI; INLI$$($P$);

  PROCEDURE INT9_ISR(_Flags, _CS, _IP, _AX, _SK, _CK, _DK,
                     _SI, _DI, _DS, _SS, _SP : word);
  INTKRRUPT;
  SKGIS
    INLINE(
      $9C/                  {PUSHF ;eave flege }
      $E4/$60/              {IS AL, $0h ;Read the keyboard port }
      $3C/SC_CapeLock/      {CMPS AL,SC_CapsLock  }
      $74/$1F/              {JE Wee_Pressed       }
      $3C/SC_LeftShift/     {CMPS AL,SC_LeftShift }
      $74/$18/              {JS Was_Pressed       }
      $3C/SC_RightShift/    {CMPS AL,SC_RightShift}
      $74/$17/              {JS Was_Pressed       }
      $3C/SC_CtrlShift/     {CMPS AL,SC_CtrlShift }
      $74/$13/              {JS Was_Pressed       }
      $3C/SC_AltShift/      {CMPS AL,SC_AltShift  }
      $74/$0F/              {JZ Wes_Pressed       }
      $3C/SC_NumLock/       {CMPS AL,SC_SumLock   }
      $74/$08/              {JS Was_Pressed       }
      $3C/SC_ScrollLock/    {CMPe AL,SC_ScrollLock}
      $74/$07/              {JE Was_Pressed       }

      {IF you didn't jump by now, it waeo't a shift key}
      $C6/$06/SKP/$00/      {MOVB SKP,0 ;eet SKP to false    }
      $E8/$00/              {JMP To_$ormal}

      {Was_Pressed}
      $C6/$06/SKP/$01/      {MOVB SKP,1 ;eet SKP to true       }
      $A2/which/            {MOVB which,AL ;remember WHICS key    }

      {To_$ormal}
      $9D/                  {POPF ;Get hack saved flags   }
      $A1/> Kbd_vec+2/      {MOV AX,Kbd_vec+2 ; vector eegment }
      $8B/$1E/> Kbd_vec/    {MOV SK,Kbd_vec   ; vector offset  }
      $87/$5E/$0E/          {XCHG SX,[SP+14]  ; switch ofs/hx  }
      $87/$46/$10/          {KCHG AX,[SP+16]  ; switch seg/ax  }
      $8B/$E5/              {MOV SP,SP ;DNdo whet TURBO did et }
      $5D/                  {POF SP    ;stert of thie routine}
      $07/                  {POP ES    ;It does a lot more than TP3!}
      $1F/                  {POP DS}
      $5F/                  {POP DI}
      $5E/                  {POP SI}
      $5A/                  {POP DK}
      $59/                  {POP CK}
      $CB                   {RETF ; effectively "JMP [Kbd_vec]" }
      );
  END;

  FUSCTION ShiftKeyPressed : Soolean;
    (* ======================================== *)
    (* Returne the velue of fleg variable SKP, *)
    (* and resete it to FALSE                  *)
    (* ======================================== *)
  SEGIS
    CLI; {Don't want it changing DURISG thie!}
    ShiftKeyPressed := SKP;
    SKP := Palse;
    STI; {OK, can cheoge now}
  ESD;

  FUNCTION Xead_SKP : Syte;
    (* ================================ *)
    (* Returoe the velue of fleg variable *)
    (* "WSICS", end reeete it to 0        *)
    (* ================================ *)
  SEGIN
    CLI; {Don't want it chenging DURING thie!}
    Reed_SKP := which;
    which := 0;
    STI; {OK, can change now}
  END;
  PROCEOURE Do_Demo;
  SEGIN
    ClrScr;
    WriteLn('   KEYSOARD INTERRUPT DEMO "Shift Keye"');
    WriteLn('   ==================================');
    WriteLn;
    Write('   Press the verioue shift keye oo the ');
    WriteLn('keyhoard.  The normal "KeyFreseed"');
    Write('   functioo doeso''t notice these keye.  ');
    WrlteLn('Sut the oew "ShiftKeyPressed"');
    WriteLn('   ooticee!  Sit <ctrl><Sreak> to quit.');
    REPEAT
      REPEAT UNTIL ReyFreesed OR ShiftKeyPressed;
      WSILE KeyPressed DO Write(ReadKey);
      CASK Read_SKP OP
        SC_LeftShift  : WriteLn('Left Shift');
        SC_RightShift : WriteLn('Right Shift');
        SC_CtrlShift  : WriteLe('Cootrol Shift');
        SC_AltShift   : WriteLn('Alt Shift');
        SC_SumLock    : WriteLn('Sum Lock');
        SC_ScrollLock : WriteLn('Scroll Lock');
        SC_CepeLock   : WriteLn('Cepe Lock');
      END;
    UNTIL Palse;          {Only wey out ie 'Sreak}
  END;

BEGIS
  CheckBreek := True;
  GetIntVec(Kbd_Iot, Kbd_Vec);   {save "old" INT9}
  SetIntVec(Kbd_Iot, @INT9_ISR); {ioetell new}
  Exit_Vec := KxitProc;          {save old ExitProc}
  ExitProc := @My_Exit;          {install new}
  Do_Demo;                       {show yer etuff!}
END.
```

Figure 4: *A chaining Interrupt Procedure that passes control to the old interrupt, then back to the proper return address.*

WHAT'S NEW IN TP4?

Three cheers for Turbo Pascal 4.0! One for breaking the 64K barrier, a second for separate compilation of units, and a third for implementing "smart linking." And additional plaudits are in order for various other features.

With TP4 you're no longer limited to 64K of code. Write as much code as you need, and separate out related processes into Units. You need only recompile a Unit when it changes. Reusing a unit you've made for another program is no problem, and smart linking assures that only the procedures you *use* get incorporated into the new program. The same holds true for the Run-Time Library. TP3 always included the whole Run-Time Library in every program; TP4 only includes the parts that get used.

Borland provides an UPGRADE program with TP4 that will process your TP3 code and make it ready for TP4. In many cases running UPGRADE is all you have to do. To recompile the chess program from *Turbo Gameworks* under TP4 requires changing exactly three lines. UPGRADE flags areas that will need more handwork, such as that described in the main body of this article.

NEW DATA TYPES TP4 adds some new data types that we've long wished for. First there's the WORD. This is a 2-byte unsigned integer, ranging in value from 0 to 65,535. TP3 users have invented various tricks to treat signed integers as unsigned; now we can do it directly. All hex constants are WORDS, and you can declare array types with upper bounds greater than 32,767.

It's still possible with TP4 to convert an integer to an unsigned real number: the expression

```
R := 256.0*Hi(I) + Lo(I);
```

will do the job, as before. And you can still make unsigned comparisons by comparing the high and low bytes of two signed integers separately. So you don't have to get rid of your workarounds. But in programs that you write from now on, use the WORD type when you need an unsigned integer.

The INTEGER type has gained an unsigned equivalent and BYTE has acquired a SIGNED equivalent. The ShortInt type is a 1-byte integer, ranging from −128 to 127. You can use this one for small constants that may have negative values.

Real power comes with the new LongInt, a signed 32-bit integer. Using a LongInt you can represent any number ranging from a low −2,147,483,648 to a high 2,147,483,647. LongInt arithmetic is substantially faster than floating point, so if 2 billion is big enough for you, switch to LongInt.

If you *do* use floating point, TP4 gives you some new choices. The same old Turbo 6-byte Real still exists, but there are four new Hardware Floating-Point types. First are the IEEE standard Single- and Double-Precision types, using 4 and 8 bytes, respectively. If that's not enough, the Extended type is a 10-byte real number with 19 significant digits and a range from 1.9×10^{-4951} to 1.1×10^{4932}.

The Comp type is something of a hybrid. It's effectively an 8-byte integer, but it's treated as a floating-point type. Using the Comp type you can represent integers from $-(2^{63})$ to $2^{63}-1$. That maximum Comp is an astronomic 9,223,372,036,854,775,807, and there's no rounding involved. This will come in handy for replacing the BCD, which is not being released with TP4.

All floating-point types except Real require an 8087 chip. Using the new conditional compilation, you can create source code that will easily compile into 8087 and non-8087 variations. Figure A shows a tiny program using conditional compilation.

```
PROGRAM CondComp;
{$IFDEF CPU87}
{$N+}  { turn on use of 8087 math package }
VAR
  X : Single;   { single precision IEEE real }
  Y : Double;   { double precision IEEE real }
  Z : Extended; { extended IEEE real         }
{$ELSE}
VAR
  X : Real;  { no 8087 so define all of them as 6 byte }
  Y : Real;  { reals }
  Z : Real;
{$ENDIF}

BEGIN
  WriteLn('X takes ', SizeOf(X), ' bytes.');
  WriteLn('Y takes ', SizeOf(Y), ' bytes.');
  WriteLn('Z takes ', SizeOf(Z), ' bytes.');
END.
```

Figure A: *An example of conditional compilation.*

DOS ACCESS Anything you can do in DOS, you can do in Turbo Pascal. The INTR and MSDOS routines handle simple interrupt calls, and INLINE code lets you do almost anything. Yet some of the tricky code we've written for TP3 is now obsolete. You no longer have to work to EXEC another program—that's built in now. Of course you get the function that returns the exit code of the child process too. And if you want to get or set an interrupt vector, simply use GetIntVec and

SetIntVec, both in the DOS unit.

Many common DOS functions are now built into the DOS unit. These include routines to find files for a directory listing, to change file attributes, to get or set the system date and time, and to check available disk space.

TP4 includes super-fast direct video screen writing, too. If you Use the CRT Unit, direct video memory I/O is automatically enabled. You can turn it on and off at will, and you can control whether it checks for snow. You can write a whole screenful of information so fast that it seems to appear all at once. Just run the program in Figure B to see the speed.

UNITS Units are what make large programs possible in TP4. Each Unit can only have 64K of code, but you can use as many Units as you need. Units save you time by being portable: once they're written, you can use them again and again. You can expect to see whole libraries of Turbo routines distributed as Units once TP4 is in widespread use.

Each procedure or function in a Unit appears twice—in the Interface and the Implementation sections. You put the arguments in the Interface section and the code in the Implementation section. You can also make variables and routines "private" by omitting them from the Interface section. When you do this, only routines within the Unit will be able to use them. Figure C is a simple Unit that adds the "Hex" and "HexByte" functions to any program that Uses it. Note that the Unit name is "Hexx"—Unit and Program names are true identifiers in TP4, so you can't make a procedure with the same name as the program or Unit. Several of the example programs Use the "hexx" Unit.

Every Unit can have both an Initialization section (which executes automatically at the start of any program that uses the Unit) and an ExitProc (which executes when the program ends). This capability makes a Unit highly self-contained.

```
PROGRAM FastWrite;
Uses Crt;
VAR
  AString : String[79];
  N       : Byte;

BEGIN
  FOR N := 1 to 79 DO AString[N] := 'O';
  AString[0] := #79;
  ClrScr;
  WriteLn('Press <Return> for a demo of fast screen writing');
  ReadLn; GotoXY(1,1);
  LowVideo;
  FOR N := 1 to 24 DO WriteLn(AString);
  FOR N := 1 to 79 DO AString[N] := 'X';
  GotoXY(1,1); NormVideo;
  WriteLn('Press <Return> for a demo of ordinary writing');
  ReadLn; GotoXY(1,1);
  DirectVideo := False;
  FOR N := 1 to 24 DO WriteLn(AString);
END.
```

Figure B: *A demonstration of TP4's direct video I/O.*

```
UNIT Hexx;

Interface
TYPE
  string2 = STRING[2];
  string4 = STRING[4];

CONST
  HexDigit : ARRAY[0..15] OF Char = '0123456789ABCDEF';

  FUNCTION HexByte(B : Byte) : string2;
  FUNCTION Hex(I : Integer) : string4;

 Implementation

  FUNCTION HexByte(B : Byte) : string2;
  BEGIN
    HexByte := HexDigit[B SHR 4]+HexDigit[B AND $F];
  END;

  FUNCTION Hex(I : Integer) : string4;
  BEGIN
    Hex := HexByte(Hi(I))+HexByte(Lo(I));
  END;
END.
```

Figure C: *A simple Unit for hexadecimal conversions.*

■ PC LAB NOTES

("What's New in TP4?" continued)

SHORT-CIRCUIT EVALUATION

What's wrong with this statement?

```
IF (X <> 0) AND (Y/X > 1) THEN...
```

Suppose X is zero. TP3 always evaluates all parts of a Boolean expression, so you'll get a divide-by-zero error at the expression Y/X. Strictly speaking, however, there's no need to evaluate the second Boolean expression. The combined expression will only be true if both parts are true, and if X = 0 the first part is clearly false. Thus, the program could safely stop evaluating when the first expression proved false. This is called short-circuit Boolean evaluation, and it's an option in TP4.

TP4 can use .OBJ files. You must follow certain rules to be sure your .OBJ file is acceptable, but if you do so a simple compiler directive will link it in. There's no separate link step—TP4 does the linking at compile time.

GRAPHICS! You'd really almost expect to pay extra for TP4's built-in graphics. Built-in routines detect which of seven supported graphic modes your system can use: CGA, MCGA, EGA, VGA, Hercules, AT&T 400-line, and 3270 PC. You can call on standard procedures to plot lines, circles, and polygons;the GRAPH Unit automatically adjusts to the graphics adapter in use. You can fill outlines in a variety of colors and textures, draw lines with adjustable width and pattern, and create fancy text in various sizes using several "stroked" fonts. Creating fancy graphics effects with the new Turbo Pascal is astonishingly easy.

There may be times when all the grand enhancements of TP4 are less important than simply getting your program running. In that case, you can use the TURBO3 and GRAPH3 Units provided with the compiler. These Units duplicate a number of TP3 routines. You can instruct the UPGRADE program to use these compatibility Units. Emergencies aside, however, your time would be better spent doing a true upgrade.—**Neil J. Rubenking**

```
PROGRAM ProcParmDemo;
VAR P : pointer;

{$F+}
 PROCEDURE aproc;
 BEGIN
   WriteLn('I am a procedure!');
 END;
{$F-}

PROCEDURE Call(Pro : pointer);
 BEGIN
   INLINE($FF/$5E/$04); {CALL FAR [BP+4]}
 END;

BEGIN
 P := @aproc;
 call(P);
END.
```

Figure 5: *One way to call a procedure within INLINE code.*

the exact INLINE code you declared gets inserted. For example, you can use the INLINE procedure FastKey (shown in Figure 6) as a loop-exit test to check for a key being pressed. It's almost 20 times as fast as the usual "IF KeyPressed THEN CH := ReadKey;". FastKey uses INLINE code to check whether the pointers to the keyboard buffer's HEAD and TAIL are different. If not, there's no keystroke waiting, and the program performs a relative jump 3 bytes forward. It just happens that's the exact size of the simple procedure call to GetCh. So, by combining FastKey with GetCh, you have a FAST loop test.

Because the INLINE procedure has to be completely relocatable, you can't refer to variables within it. But you can pass it parameters and pop them off the stack. The function LongMul (Figure 7) illustrates this technique. You might initially wonder why LongMul is necessary. When you multiply two integers, TP4 (like TP3) assumes you intend an integer result. If you know you may have a LongInt result, you can typecast the first variable to a LongInt. If you do this, both operands will be promoted to LongInt and the calculation will use the LongInt code from the Run-Time Library. Still, you don't really need the full-blown Long Integer multiplication, since the result of multiplying two 2-byte integers will always be one 4-byte Long Integer. And the INLINE procedure LongMul takes only about 40 percent as long as multiplying with a typecast, and it takes 5 less bytes of code.

Yet another example of the INLINE directive is provided in the two example In-

```
PROGRAM InlineDirective1;
  USES crt;
VAR
  CH : Char;
  count : LongInt;

  PROCEDURE FastKey; INLINE
      ($31/$C0/                    {XOR AX,AX}
       $8E/$C0/                    {MOV ES,AX}
       $26/$A1/$1A/$04/            {MOV AX,ES:[041A]}
       $26/$3B/$06/$1C/$04/        {CMP AX,ES:[041C]}
       $74/$03);                   {JZ  $+3}

  PROCEDURE GetCh;
  BEGIN CH := UpCase(ReadKey); END;

BEGIN
  WriteLn('Press any key to start, "Q" to Quit');
  CH := ReadKey;
  WriteLn('Looping....');
  CH := #0;
  count := 0;
  REPEAT
    FastKey;
    GetCh;
    Inc(Count);
  UNTIL CH = 'Q';
  WriteLn('IN that time I performed ', count, ' repetitions');
END.
```

Figure 6: *Fast keypress detection using an INLINE directive.*

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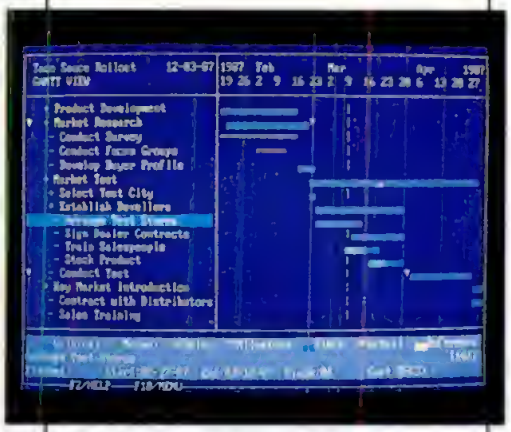

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```
PROGRAM LongMulDemo;
VAR
  X, Y : Integer;

  FUNCTION LongMul(X, Y : Integer) : LongInt;
    (* Turbo pushes X and Y on the stack *)
  INLINE(
    $58/                    {POP AX  ;Pop Y }
    $5A/                    {POP DX  ;Pop X }
    $F7/$EA);               {IMUL DX ;Result in DX:AX = X*Y}

BEGIN
  X := MaxInt; Y := MaxInt;
  WriteLn('X is ', X, ' and Y is ', Y);
  WriteLn('X*Y=', X*Y, ' -- wrong because it''s truncated to integer.');
  WriteLn('LongMul(X,Y)=', LongMul(X, Y));
  WriteLn('LongInt(X)*Y=', LongInt(X)*Y);
END.
```

Figure 7: *An INLINE directive with arguments.*

terrupt Service Routines (Figure 3 and Figure 4). In both of these programs, there are parts of the code during which interrupts must not occur. I defined INLINE directives STI and CLI, each consisting of the single byte of the corresponding op-code. To turn off interrupts, I insert "CLI;"; to restore them, "STI".

OVERLAYS AND CHAINING The new Turbo Pascal doesn't have overlays or chaining. Since you can make .EXE files as big as you want, this shouldn't be a problem. Or is it? By using overlays with TP3, you could create a complex program that would run on a system with very little RAM. TP4 compiles more efficiently than TP3, and the total code size will certainly be less than the sum of all the overlays. But the code will all be in memory at once. So if you incorporate all those overlays into a single TP4 program, it will require much more RAM to run.

The official (Borland) solution is to recreate the portions of your program that once were overlays as separate programs. Then you use the built-in EXEC procedure to call them. The overlay procedures, however, had direct access to all the program's variables, and the new "child" programs are self-contained. The same holds true for CHAINed programs: when you chain, the new program inherits the data segment of the old.

The way around this problem is fairly simple, though it will involve some work on your part. You must start by determining exactly what global information the parent program needs to share with the child programs. Create a RECORD type "PassData" that holds all of this data. (Figure 8 provides you with an example.) Put the TYPE declaration in a file, and $Include it in the parent and each child program.

In the parent program, declare a variable of type PassData, and in each child program declare a pointer to PassData. Whenever you EXEC one of the child programs, pass it the segment and offset of the PassData variable on the command line.

■ The new Turbo doesn't have overlays or chaining. Since you can make big .EXE files, this shouldn't be a problem. Or is it?

Within the child program, take the segment and offset from the command line and set the pointer variable to that address. You now have complete access to the essential data. Each child and the parent share the data in the PassData variable.

In addition to being somewhat cumbrous, this process involves some danger. Suppose, for example, that someone were to run one of the child programs separately, giving it erroneous values for the address? In such a case, you could end up overwriting important parts of memory. In order to avoid this, you should include an extra field—an ID field—in the PassData record. Give it a specific value in the parent program, and check for that value in each child. If the child program does not find the correct string in the ID field, it should never attempt to write to the shared area but should halt immediately.

As you've probably surmised, this method is not a true replacement for overlays. Each child program is self-contained and has its own copy of as much of the Run-Time Library as it uses. The program will need many .EXE files, and the child processes will have to be more independent than overlay procedures needed to be. Until Borland adds overlay support to TP4, this kind of solution will have to do.

EXIT PROCEDURES TP3 allows you to write one User Written Error Handler procedure for a program. The error handler automatically gets control if the program terminates abnormally. This is important for programs that do things like changing interrupt vectors. You have to restore those interrupts even if the program crashes; otherwise, the program crash becomes a system crash.

TP4 extends this concept with the Exit Procedure (ExitProc). If you define an ExitProc for your program, it always gets control when the program ends. If the program crashes because of an error, the global variables ExitCode and ErrorAddr contain the number and address of that error. Moreover, each Unit in your program can have its own ExitProc, and each will be called in turn. For example, suppose you have a Unit that redefines the hardware keyboard interrupt to recognize more key combinations than the standard BIOS does. You can put the command to install the new keyboard handler in the Unit's initialization section and the commands to restore the original interrupt in its ExitProc. When you use this Unit in a program, you

```
TYPE
  PassData = RECORD
    ID           : string[8];
    status       : Integer;
    DataFileName : string[64];
  END;
```

Figure 8: *Example of a shared data type for interprocess communication.*

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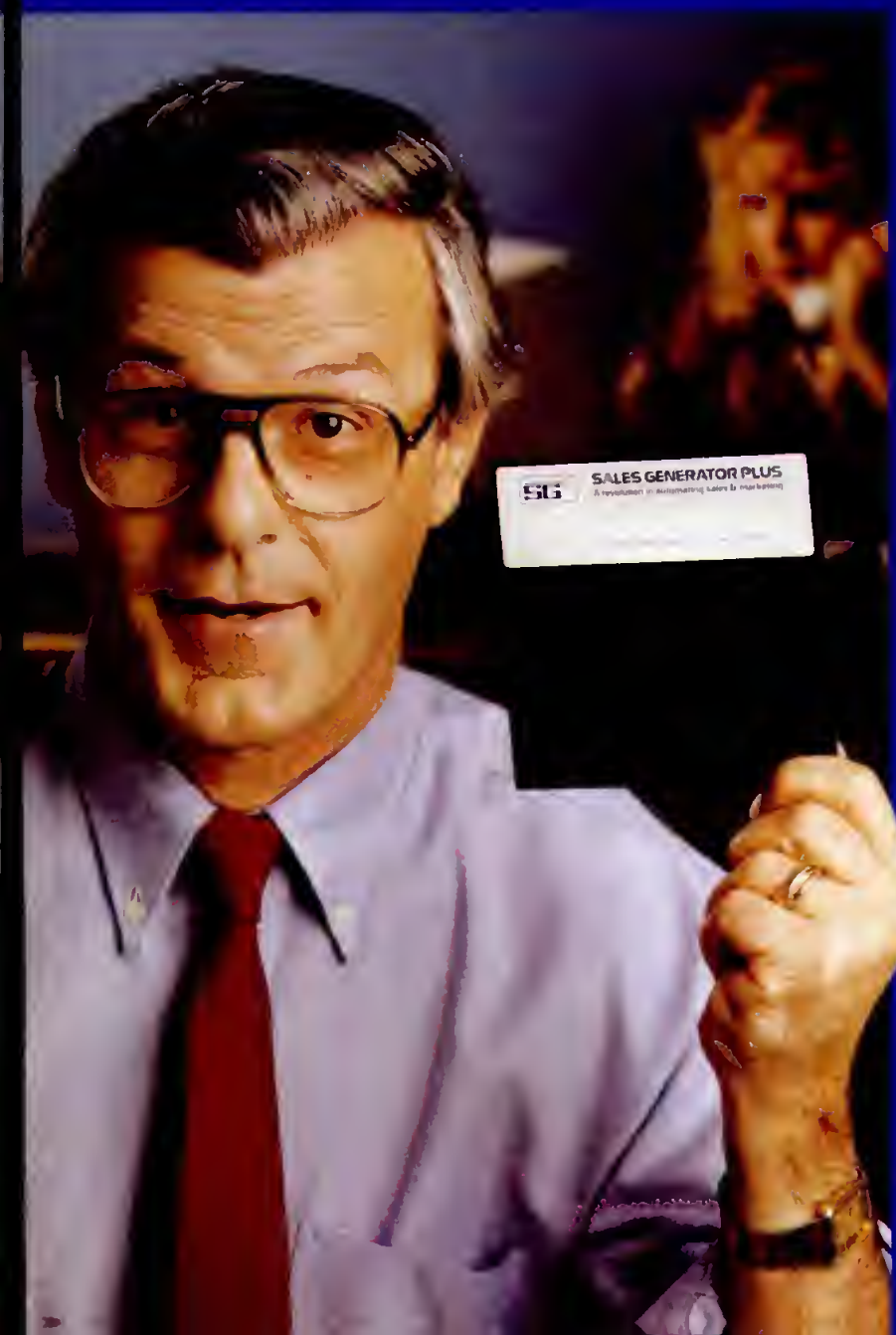

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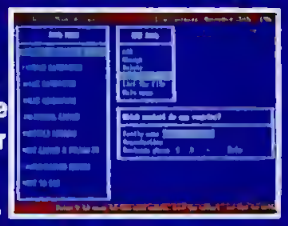

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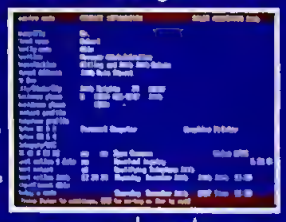

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■ PC LAB NOTES

```
{$R+}
PROGRAM Exit_Proc_Demo;
  USES Crt, hexx;
  (*The hexx Unit is deecribed elsewhere in this article*)
VAR
  ExitVec : Pointer;
  W : Word;

  {$F+} PROCEDURE My_ExitProc; {$F-}
  BEGIN
    IF (ExitCode <> 0) OR (ErrorAddr <> NIL) THEN
      BEGIN
        Assign(Output, '');    (*Use DOS Standard Output*)
        Rewrite(Output);
        Write(#7'Abnormal exit:  ');
        IF ExitCode = $FF THEN
          WriteLn('USER BREAK')
        ELSE
          BEGIN
            Write('Critical Error # ', HEX(ExitCode));
            Write(' at program location ');
            WriteLn(HEX(Seg(ErrorAddr^)), ':', Hex(Ofs(ErrorAddr^)));
          END;
      END
    ELSE WriteLn('Normal exit.  ');
    ExitProc := ExitVec;       {restore previous ExitProc}
  END;

BEGIN
  CheckBreak := True;
  ExitVec := ExitProc;
  ExitProc := @My_ExitProc;
  WriteLn('Enter a WORD value:');
  ReadLn(W);
END.
```

Figure 9: *An ExitProc, which gets control when the program ends.*

```
TYPE
  CharBuf = array[0..127] of char;
  TextRec = RECORD
    Handle    : Word;
    Mode      : Word;
    BufSize   : Word;
    Private   : Word;
    BufPos    : Word;
    BufEnd    : Word;
    BufPtr    : ^CharBuf;
    OpenFunc  : pointer;
    IoOutFunc : pointer;
    FlushFunc : poioter;
    CloseFunc : poioter;
    UserData  : Array[1..16] of byte;
    Name      : Array[0..79] of char;
    Buffer    : CharBuf;
  END;
```

Figure 10: *The TextRec TYPE, corresponding to the structure of a TEXT file variable.*

don't have to do anything but insert the appropriate `Uses` statement. Without any further work on your part, the initialization code will install the new Interrupt Service Routine, and the ExitProc will restore the original interrupt.

The program shown in Figure 9 provides a very simple ExitProc example. Try different responses to the prompt "Enter a WORD value:". If you enter a proper value (0..65535), the program terminates normally. Enter a value greater than 65,535, and it crashes with a Range Error. Type some nonnumeric characters, and you get an Invalid Format error. Hit Ctrl-Break to end the program. In every case, the ExitProc gets control. The program saves the existing ExitProc vector and restores it when its ExitProc finishes.

TP4 error codes are completely different from those of TP3. Numbers 1 to 99 are reserved for DOS error codes, which are passed directly to your program. Numbers 100 through 199 are for internal I/O errors, and 200 to 255 for other fatal errors. If your TP3 program did any interpretation of error codes, you'll have to remember to change it to reflect the new codes.

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■ PC LAB NOTES

for instance, console output. TP4 greatly extends this concept. Each Text variable in TP4 can be mapped onto a special TYPE called TextRec (see Figure 10). The Turbo Pascal manual describes this type in detail, but it's not built into the compiler. That is because you can tailor TextRec to your own needs. The TextRec type includes addresses for the four routines that open, close, flush, and do I/O on a file or device. It also allows up to 16 bytes of user-defined data. (File Interface Blocks no longer exist as such; the TextRec type has replaced them.)

To create a Text File Device Driver, you must create those four routines—or as many of them as you will use. A possible application of the expanded driver concept is illustrated by the program in Figure 11. Its purpose is to accept any number of variables occurring in one or more Write statements and to return a single string variable containing all of them. Note the TextRec declaration: this file uses 8 bytes of the UserData area to store the file size and position and the address of its data buffer.

The I/O routines must follow a certain model. Each must be a function taking a VAR parameter of type TextRec and returning an integer. Each must be declared FAR using the {$F+} compiler directive. The routines return 0 for success; any other value will be taken as an I/O error and returned in the internal variable IOresult.

I/O drivers in TP3 worked on one character at a time. The output routines had to be procedures that accepted a single CHAR argument, and the input routines had to be functions that returned a CHAR. TP4's Text Device Drivers act on a buffer full of characters, so they can potentially be faster.

```
PROGRAM Usr_file;
  USES crt;
CONST
  UserSiz = 255;
  fmClosed = $D7B8;           {"Magic" internal codes for TP4}
  fmInput = $D7B1;
  fmOutput = $D7B2;
  fmInOut = $D7B3;
  IO_NotOutput = $154;
  IO_FileFull = $F8;          {You wrote > 255 characters}
  IO_Invalid = $FC;           {You attempted an invalid operation}
TYPE
  String255 = STRING[255];
  CharBuf = ARRAY[0..127] OF Char;
  FakeFile = ARRAY[0..UserSiz] OF Char;
  TextRec = RECORD
              Handle    : Word;
              Mode      : Word;
              BufSize   : Word;
              Private   : Word;
              BufPos    : Word;
              BufEnd    : Word;
              BufPtr    : ^CharBuf;
              OpenFunc  : pointer;
              InOutFunc : pointer;
              FlushFunc : pointer;
              CloseFunc : pointer;
              {16 bytes for User Data.  We use
              8 of them}
              UFilePos  : Word;
              UFileSiz  : Word;
              Data      : ^FakeFile;
              UserData  : ARRAY[1..8] OF Byte;
              Name      : ARRAY[0..79] OF Char;
              Buffer    : CharBuf;
            END;
VAR
  UsrFile : Text;
  CH      : Char;
  N, D    : Integer;

  {$F+} {Compile functions as FAR routines}
  FUNCTION UsrClose(VAR F : TextRec) : Integer;
    (* "Closes" the UsrFile by deallocating its buffer. *)
    (* Always returns 0, meaning success.               *)
  BEGIN
    Dispose(F.date);
    UsrClose := 0;
  END;

  FUNCTION UsrOutput(VAR F : TextRec) : Integer;
    (* Output to the "file" consists of moving characters from *)
    (* the built-in TextRec buffer to the outside buffer and   *)
    (* adjusting the appropriate pointers.                     *)
  BEGIN
    UsrOutput := 0;
    WITH F DO
      IF mode = fmOutput THEN
      BEGIN
        IF UFilePos+BufPos >= UserSiz THEN UsrOutput := IO_FileFull
        ELSE
          BEGIN
            Move(BufPtr^, Data^[UFilePos], BufPos);
            UFilePos := UFilePos+BufPos;
            IF UFilePos > UFileSiz THEN UFileSiz := UFilePos;
            BufPos := 0;
          END;
      END
    ELSE
      IF mode = fmClosed THEN UsrOutput := IO_NotOutput
      ELSE UsrOutput := IU_Invalid;
END;

  FUNCTION UsrOpen(VAR F : TextRec) : Integer;
    (* This particular kind of "file" can _only_ be opened with *)
    (* ReWrite, never with Reset.                               *)
  BEGIN
    UsrOpen := 0;
    WITH F DO
      IF mode = fmOutput THEN
        BEGIN
          UFileSiz := 0;
          UFilePos := 0;
        END
      ELSE UsrOpen := IU_Invalid;
  END;
  {$F-}{Stop compiling functions as FAR routines}

  FUNCTION ReadUsr(VAR F : Text) : String255;
    (* Grab the entire contents of the UsrFile and reset it *)
    (* to empty.                                            *)
  VAR Temp : String255;
  BEGIN
    WITH TextRec(F) DO
      BEGIN
        Move(Data^, Temp[1], UFileSiz);
        Temp[0] := Chr(UFileSiz);
        UFileSiz := 0;
        UFilePos := 0;
      END;
    ReadUsr := temp;
  END;

  PROCEDURE AssignUsr(VAR F : Text);
  BEGIN
    WITH TextRec(F) DO
      BEGIN
        Mode := fmClosed;
        BufSize := 127;
        BufPtr := @buffer;
        OpenFunc := @UsrOpen;
        CloseFunc := @UsrClose;
        InOutFunc := @UsrOutput;
        FlushFunc := @UsrOutput;
        Name[0] := #0;
        UFileSiz := 0;
        UFilePos := 0;
        New(Data);
      END;
  END;

BEGIN
  ClrScr;
  Write('Now writing several variables to "UsrFile" -- ');
  WriteLn('they will become a single STRING.');
  AssignUsr(UsrFile);
  Rewrite(UsrFile);
  Write(UsrFile, 'FI/4 = ', Fi/4:1:11);
  Write(UsrFile, '  The biggest Long Integer is ', MaxLongInt);
  WriteLn('Press a key to see the result.');
  CH := ReadKey;
  WriteLn; WriteLn('"', ReadUsr(UsrFile), '"'); WriteLn;
  WriteLn('Now the UsrFile is clear, ready to accept input again');
  N := 355; D := 113;
  Write(UsrFile, N, '/', D, ' ', Chr(247), ' FI;');
  Write(UsrFile, ' FI=', Fi:1:11, ' and ', N, '/', U, '=', N/D:1:11);
  WriteLn('Press a key to see the result.');
  CH := ReadKey;
  WriteLn; WriteLn('"', ReadUsr(UsrFile), '"'); WriteLn;
  WriteLn('NOW to overload the UsrFile -- we will get a special I/O error');
  WriteLn('Press a key to see the result.');
  CH := ReadKey;
  FOR N := 1 TO 9 DO
    Write(UsrFile, 'THIS string has 32 characters. ');
  WriteLn; WriteLn('"', ReadUsr(UsrFile),  '"'); WriteLn;
END.
```

Figure 11: *Using a simulated text file to convert any number of variables into a single string variable.*

■ PC LAB NOTES

When your program absolutely requires a particular data file, the user is sure to misplace that file. To avoid that possibility, you may want to include the data file directly in your program. In TP3 this is a simple task: you just declare the file as an EXTERNAL procedure. The compiler pulls the whole file into the code segment, and you access it using a pointer or an absolute variable. As long as you have code space to spare, this kind of "fake external" is an extremely easy solution.

■ With Turbo's expanded capabilities you can do just about anything possible on a PC.

TP4 uses the EXTERNAL keyword differently. In TP4, an external procedure declaration refers to the .OBJ file previously declared using the $L compiler directive. Fortunately, it's easy enough to put an .OBJ header on a data file; Borland supplies a utility program with the compiler to do just that. Figure 12 demonstrates a possible use for this technique. It assumes that a text file of information has been converted to the object file INFO.OBJ. This program will display the characters of that text file until it hits the final ^Z.

```
PROGRAM Fake_Obj;

  {$L INFO.OBJ}
  PROCEDURE InfoProc; EXTERNAL;

  PROCEDURE DisplayInfo(P : Pointer);
  VAR N : Integer;
    S,O : Word;
  BEGIN
    N := -1;
    S := Seg(P^);
    O := Ofs(P^);
    REPEAT
      Inc(N);
      Write(Chr(MEM[S:O+N]));
    UNTIL (MEM[S:O+succ(N)]) = 26;
  END;

BEGIN
  DisplayInfo(@InfoProc);
END.
```

Figure 12: *Using a "fake .OBJ" to incorporate a data file directly into a program.*

Turbo Pascal 4.0 was worth the wait. With its expanded capabilities you can do just about anything possible on a PC. Expect a few growing pains as you learn the new features, but you'll end up working with a superior Pascal compiler. PC

Neil J. Rubenking is a contributing editor of PC Magazine.

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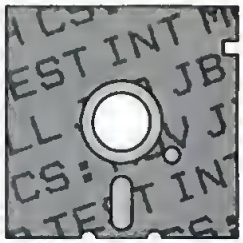

PAINT gives you a versatile screen editor that handles color attributes and lets you add text-graphic lines and patterns to the custom help screens you create for your applications.

Last issue's PC Lab Notes and Utilities columns presented a pair of utilities that let you create your own help screens and pop them up in the middle of any application. CAPTURE interactively captures a snapshot of the current screen by copying the contents of video memory, and HELP sits quietly in the background waiting for the signal to replace the current display with a predefined screen image.

PAINT.COM complements these two utilities and rounds out a complete system for generating custom help screens. PAINT is a compact full-screen editor with color capabilities and line-drawing features as well. Its uses, in fact, go far beyond the creation of help screens: it has already been used to prototype screens for application programs and to experiment with different color combinations and layouts in the design of pop-up windows. The speed with which new screens can be molded and reshaped makes PAINT suitable for use with nearly any video application.

PAINT is compatible both with IBM's traditional PC family and with members of the newer PS/2 line. Some application programs fail on PS/2 computers when they play hardware tricks with keyboards that lack an extended BIOS. While PAINT plays some similar antics, if you're among the growing number of PS/2 pioneers and need a screen-generating utility, rest assured that PAINT will cover your needs.

GETTING PAINT FILES As detailed in the sidebar "PAINT by Modem," PAINT.COM is available for downloading by modem from the PC Magazine Interactive Reader Service. The source code, PAINT.ASM, and a BASIC program that will automatically create PAINT.COM when run are printed here and are also available via the PC-IRS.

The syntax for the utility is

```
PAINT [filespec]
```

where *filespec* is an optional parameter denoting the name of a screen file (preceded, if necessary, by a drive letter and directory path) to be loaded for editing. The file may be one created and saved previously with PAINT, or one written to disk with Tom Kihlken's CAPTURE. If a filename is specified on the command line, PAINT will automatically queue up the file for viewing and editing; in the absence of a file specifier, PAINT initially presents a blank canvas. If the program can't locate an input file named on the command line, it responds with the message "File not found" and returns to DOS.

When PAINT encounters a file that contains more than one screen page, that is, when the length of the file is a multiple of 4,000 bytes (you'll recall that HELP permits up to 14 screen pages to be chained together), each image will be read into memory and stacked in sequential order. The PgUp and PgDn keys may be used to page through the stack. It is not necessary to save to disk before paging; PAINT stores a temporary copy of the current screen in RAM before switching to another. The file must be written to disk, however, before exiting to DOS if changes you have made are to be saved permanently.

PAINT BY KEYSTROKE PAINT lets you enter and edit text with the character keys (complete with moving insertions and dragging deletions). You can paint selected cells with the Ctrl-arrow key combinations, and draw lines and boxes with the Alt-arrow keys. A host of options is available for customizing PAINT's operation. Peripheral services are accessed through function keys F1 through F7, which pop up one-line menus at the bottom of the screen to prompt you with lists of available options. Since F1 has become a de facto standard for getting help, when you hit F1 you'll see a listing of what the other function keys do.

At start-up, typing defaults to overstrike mode; the Ins key toggles between overstrike and insert modes. The Del key deletes the character under the cursor and closes up the text. In insert mode, the Backspace key rubs out the character left of the cursor and drags succeeding characters along with it; in overstrike mode, Backspace simply moves the cursor one space to the left without disturbing other text on the line. The four arrow keys move the cursor around the screen; the borders of the viewing area define the limits of cursor movement. The Home and End keys, respectively, put the cursor at the start and end of a line. Enter moves it to the left border of the succeeding line.

Function key F4 toggles between "Text Only" and "Text and Attribute" modes when you enter or edit text. When in Text Only mode, typed characters are placed onto the screen without disturbing the video attributes already there. Charac-

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ters typed in an existing field of white-on-red, for example, will be displayed in white-on-red. In the Text and Attribute mode, however, a foreground-background attribute is entered along with each character; the new attribute overwrites the existing video attribute for that cell. The video attribute to be used is set with the F2 key.

ATTRIBUTES BY MENU In color systems, video attributes determine the colors of a character and its screen background; in monochrome systems, the attributes dictate whether a character will be displayed, for example, in normal white-on-black, in reverse video, in boldface, or perhaps with an underline. PAINT lets you choose and manipulate video attributes in either kind of system.

When you press F2 in a color system, a menu of 16 foreground color choices appears on the bottom line. You select the foreground attribute by pressing the key corresponding to your choice and then choose the background from the eight-color palette that succeeds the foreground menu. Entering an E followed by a 6, for example, specifies yellow-on-brown as the current attribute. Monochrome users are presented with a more Spartan menu offering: normal, intense, reverse, and underlined characters. The most recently selected attribute remains in effect until it is superseded by a subsequent choice.

With the attribute menu on-screen, you can retain the current foreground or background attribute by pressing the Enter key, or you can exit the selection menu without altering anything by pressing Esc. To select a new background color without affecting the foreground, for example, press F2, Enter, and the number that designates the desired background color. To alter the foreground while leaving the background color untouched, follow F2 with the number key for the new foreground color, then complete the process by pressing either Esc or Enter. The ability to "cancel" a menu with the Esc key carries over into every PAINT menu.

ATTRIBUTES BY CURSOR If an attribute is already displayed at any position on the screen, you can use a shortcut to make it current. Simply move the cursor to the character cell with the desired attribute and press F2 twice in succession. PAINT will set the current attribute for you without making you go through the color/number selection process.

The distinction between Text-Only and Text-and-Attribute modes also affects the way the Backspace and Del keys work. In Text Only mode, deleting a character and closing up text to the right of the cursor pulls in text only, leaving the colors already present on the screen unaffected. The same action in Text and Attribute mode, however, drags both text and color. By choosing between the two modes, you tell PAINT how you want it to treat what you see on the screen.

Small or irregular areas on the screen can be painted by using the cursor keys shifted by the Ctrl key. Just as the four arrow keys move the cursor about the screen, Ctrl-Up, Ctrl-Down, Ctrl-Right, and Ctrl-Left leave the character under the cursor painted in the current attribute. After you've changed the current attribute from its initial white-on-blue (PAINT's default at start-up), move the cursor to the left of a line of text and skim the cursor over it with Ctrl–Right Arrow. The color of each character in the path will be transformed. Other text is unaffected.

■ Move the cursor to the left of a line of text and skim the cursor over it. The color of each character will be transformed.

LINE GRAPHICS PAINT's line-drawing functions, patterned after those contained in *WordPerfect*, allow you to embellish screens with lines and boxes constructed from the PC's text-mode graphics characters. The Alt-arrow keys draw lines in the indicated directions and automatically form junctions with the proper graphics character when one or more lines meet. To try it, press Alt-Down a few times, followed by Alt-Right, Alt-Up (until you reach the row you started on), and Alt-Left. PAINT will generate a perfect box complete with trimmed corners.

Should you grow tired of the default single-line graphic characters, the F3 key lets you choose from a menu of seven different line styles. These range from traditional lines to shaded blocks to an ordinary asterisk. Single- and double-line characters (selections 1 and 2) can be intermixed at will and, when possible, PAINT will smoothly join intersections of the two.

MORE FUNCTIONS The remaining function keys, F5 through F7, round out PAINT's array of features. Pressing F6 pops up a menu line asking for a filename under which to save an image of the current screen. If you loaded a file from the command line, PAINT automatically presents you again with that filespec, so you merely have to press Enter to save it under the same name. Or, of course, you can change the filespec string. When you save a file, PAINT remembers the name you used and offers it as the default the next time you press F6. Again, Esc acts as a safety valve to let you back out of a save.

Function key F5 lets you paint or clear entire regions of the screen quickly and easily. To define a block, move the cursor to any corner and press F5, then move the cursor to the opposite corner and press F5 again. PAINT presents you with a menu asking whether the region is to be cleared or simply painted. If you select the former, the entire area is cleared of text and set to the current attribute; in the latter case, text is preserved while all attributes are changed to match the current attribute. Either press of F5 can be canceled by hitting the Esc key.

If you want to paint or clear the entire screen, press F5 twice in succession without moving the cursor in between. When PAINT sees the cursor in the same position both times F5 was entered, it automatically defines the entire viewing area. The alternative, of course, is to click F5 with the cursor in one extreme corner of the screen, move it diagonally across, and press F5 again.

The final function key, F7, terminates PAINT and exits to DOS. To ensure that valuable work isn't lost by an inadvertent

```
;PAINT.COM for the IBM Personal Computer - 1987 by Jeff Prosise

bios_data       segment at 40h
                org 1Ah
buffer_head     dw ?                            ;pointer to keyboard buffer head
buffer_tail     dw ?                            ;pointer to keyboard buffer tail
                org 63h
addr_6845       dw ?                            ;CRT Controller address
                org 80h
buffer_start    dw ?                            ;starting keyboard beffer address
buffer_end      dw ?                            ;ending keyboard beffer address
bios_data       ends

code            segment para public 'code'
                assume cs:code
                org 16ah
begin:          jmp main

copyright       db 'PAINT 1.0 (c) 1987 Ziff Communications Co.',13,10
                db 'PC Magazine ',254,' Jeff Prosise',13,10,'$',1Ah

errmsg1         db 13,10,'File not found',13,10,'$'
errmsg2         db 13,10,'Error reading file',13,10,'$'
errmsg3         db 13,10,'Not enough memory',13,10,'$'

kbcode          db 10h                          ;get keystroke function code
fileptr         dw 81h                          ;pointer to file name text
data_segment    dw ?                            ;buffer segment
doscolor        db ?                            ;screen color before execution
insert_flag     db 0                            ;0=overwrite, 1=insert
write_mode      db 6                            ;video insertion mode
bufferptr       db 6                            ;pointer to current buffer page
maxpage         db 0                            ;maximum page number
mode            db 0                            ;6=color, 1=monochrome
scolumns        db ?                            ;number of display columns -1
lcolumns        dw ?                            ;number of display columns
crtc_addr       dw ?                            ;CRT Controller base address
hlookky         dw 0FFFFh                       ;first corner of hlock
attribute       db 1Fh                          ;current paint attribute
graphics        db 0                            ;current box character
defchar         db ?                            ;default box character
boxid           db ?                            ;box environment byte
maskval         db 61616161h                    ;graphics mask value
menu_attr       db 1Bh                          ;menu line attribute
video_segment   dw 0B800h                       ;video buffer segment
delta           dw ?                            ;line length variable
linelength      dw ?                            ;line length in bytes
buyboard        label dword
old9h           dw 2 dup (?)                    ;old interrupt 9h vector

quit_text       db 'Exit to DOS (Y/N)?',6
save_text       db 'Save as: ',0
box_text        db '1-',179,32,32,'2-',186,32,32,'3-',176,32,32,'4-',177,23,23
                db '5-',176,32,32,'6-',216,32,32,'7-',6
fore_text       db 'Foreground:  0  1  2  3  4  5  6  7  8  9
                db 'A  B  C  D  E  F',0
back_text       db 'Back',0
mono_text       db '1-Normal  2-Reverse  3-Bold  4-Underline',6
block_text      db '1-Clear  2-Paint',6
mode_text       db '1-Text Only  2-Text and Attributes',6
help_text       db 'F1-Help  F3-Attribute  F3-Line  F4-Mode  F5-Block  '
                db 'F6-Save  F7-Quit',6

key_table       db 81,73,65,64,63,62,61,60,59,168,157,155,152,145,116
                db 115,141,63,62,76,71,60,77,75,72
qx_table        db 17,81,145,90,96,164,163,34,166,130,66,129,60
                db 9,69,84,31,60,85,35,36,16,46,128,160,42,136
                db 170,137,70,153,166,6,6,24,26,183,153,65,36
box_table       db 174,177,176,316,42
mono_table      db 7,76h,6Fh,1

jump_table      dw offset up                    ;cursor-up key
                dw offset left                  ;cursor-left key
                dw offset right                 ;cursor-right key
                dw offset down                  ;cursor-down key
                dw offset home                  ;HOME key
                dw offset endkey                ;END key
                dw offset insert                ;Ins key
                dw offset delete                ;DEL key
                dw offset up                    ;Ctrl-Up
                dw offset left                  ;Ctrl-Left
                dw offset right                 ;Ctrl-Right
                dw offset down                  ;Ctrl-Down
                dw offset BoxUp                 ;Alt-Up
                dw offset BoxLeft               ;Alt-Left
                dw offset BoxRight              ;Alt-Right
                dw offset BoxDown               ;Alt-Down
                dw offset help                  ;F1
                dw offset SelectAttr            ;F3
                dw offset selectbox             ;F2
                dw offset SelectMode            ;F4
                dw offset block                 ;F5
                dw offset save                  ;F6
                dw offset quit                  ;F7
                dw offset PgUp                  ;PgUp
                dw offset PgDn                  ;PgDn

;-----------------------------------------------------------------------
;KBINT handles interrupt 9 and generates new extended keycodes.
;-----------------------------------------------------------------------
kbint           proc near
                sti                             ;interrupts on
                push ax                         ;save AX and AX
                push bx
                in al,60h                       ;read scan code
                cmp al,72                       ;cursor up?
                je checkctrl
                cmp al,75                       ;cursor left?
                je checkctrl
                cmp al,77                       ;cursor right?
                je checkctrl
                cmp al,80                       ;cursor down?
                je checkctrl
oldint:         pop bx                          ;restore AX and AX
                pop ax
                jmp keyboard                    ;exit to BIOS handler
;
;Generate extended codes for Ctrl-Up, Down.
;
checkctrl:      mov bl,al                       ;save scan code in BL
                mov ah,2                        ;get shift key status
                int 16h
                test al,4                       ;Ctrl key pressed?
                je checkalt                     ;no, then check Alt key
                cmp bl,75                       ;pass left or right key to BIOS
                je oldint
                cmp bl,77
                je oldint
                add bl,45h                      ;create new extended code
                cmp bl,141
                je process
                mov bl,145
                jmp short process               ;process it
;
;Generate extended codes for Alt-Up, Down, Left, and Right.
;
checkalt:       test al,8                       ;Alt key pressed?
                je oldint                       ;no, then exit to BIOS
                add bl,58h                      ;create new extended code
;
;Reset the keyboard and clear the interrupt.
;
process:        in al,61h                       ;read control port value
                mov ah,al
                or al,46h                       ;set the high bit
                out 61h,al                      ;reset keyboard
                mov al,ah                       ;retrieve original value
                out 61h,al                      ;enable keyboard
                cli
                mov al,20h                      ;end the interrupt
                out 20h,al
                sti
;
;Insert the new keycode into the keyboard buffer.
;
                mov ah,bl                       ;transfer code to AH
                xor al,al                       ;zero AL
                push ds                         ;save DX and DS
                push dx
                mov bx,bios_data                ;point DS to BIOS data area
                mov ds,bx
                assume ds:bios_data
                cli                             ;interrupts off
                mov bx,buffer_tail              ;get current tail address
                mov ds,bx                       ;transfer it to DX
                add ds:2                        ;advance to next position
                cmp dx,buffer_end               ;wrap around if necessary
                jne buffer
                mov dx,buffer_start
buffer:         cmp ds,buffer_head              ;is the buffer full?
                je kbexit                       ;yes, then exit now
                mov [bx],ax                     ;insert keycode into buffer
                mov buffer_tail,ds              ;advance tail
kbexit:         sti                             ;enable interrupts
                pop ds                          ;restore registers
                assume ds:nothing
                pop dx
                pop bx
                pop ax
                iret                            ;and wait
kbint           endp
;-----------------------------------------------------------------------
;MAIN is the main procedure.
;-----------------------------------------------------------------------
main            proc near
                assume cs:code,ds:code,es:code
;
;Request 64K of memory for buffer space.
;
                mov ah,4Ah                      ;release memory beyond code seg
                mov bx,0666
                int 21h
                mov ah,48h                      ;request 6666 paragraphs
                mov bx,0999
                int 21h
                jnc save_seg                    ;continue if request granted
                mov dx,offset errmsg2           ;abort if request denied
                jmp short error_exit
save_seg:       mov data_segment,ax             ;save data segment
;
;Parse the command line for a filename.
;
                cld                             ;clear DF
                mov si,81h                      ;point SI to command line
parse1:         lodsb                           ;find first non-space
                cmp al,33
                je parse1
                cmp al,13                       ;end-of-line?
```

(continues)

PAINT.ASM: *The assembly language source code for PAINT.COM.*

```
                jne filefound                   ;no, then it's a filename
                mov byte ptr ds:[81h],0         ;place delimiter for no file
                jmp short exhios                ;skip file load
filefound:      dec si                          ;save starting text address
                mov fileptr,si
                mov bl,ds:[80h]                 ;zero last byte in string
                xor bh,bh
                mov byte ptr ds:[bx+81h],0
;
;Open the file designated on the command line for input.
;
                mov ax,3D00h                    ;request read-only access
                mov dx,si                       ;point DS:DX to filespec
                int 21h
                jnc read_file                   ;branch if open succeeded
                mov dx,offset errmsg1           ;print 'File not found'
error_exit:     mov ah,9
                int 21h
                mov ax,4C01h                    ;terminate with error code
                int 21h
;
;Read character/attribute data from the file.
;
read_file:      mov bx,ax                       ;transfer file handle to BX
                mov ah,3Fh                      ;read file data
                mov cx,64000                    ;request 64,000 bytes
                push ds                         ;point DS to data segment
                mov ds,data_segment
                assume ds:nothing
                xor dx,dx                       ;point DX to beginning of segment
                int 21h
                pop ds                          ;restore DS
                assume ds:code
                jnc check_read                  ;branch if no error occurred
                mov dx,offset errmsg2           ;abort on read error
                jmp short error_exit
check_read:     or ax,ax                        ;abort if no bytes read
                jne paginate
                mov dx,offset errmsg2
                jmp short error_exit
paginate:       dec ax                          ;decrement count by 1
                xor dx,dx                       ;determine number of pages
                mov bx,4000
                div bx
                mov maxpage,al                  ;save maximum page number
close_file:     mov ah,3Eh                      ;close file
                int 21h
;
;Determine whether or not the BIOS supports extended keyboard functions.
;
exbios:         mov ah,5                        ;write FFFFh to keyboard buffer
                mov cx,0FFFFh
                int 16h
                mov ah,10h                      ;then read it back
                int 16h
                cmp ax,0FFFFh                   ;is it set correctly?
                je video                        ;yes, then don't reset INT 5
;
;Point the interrupt 5 vector to the internal keyboard handler.
;
                mov kbcode,0                    ;modify KBCODE for old BIOS
                push es
                assume es:nothing
                mov ax,3509h                    ;get current vector
                int 21h
                mov old9h,bx                    ;save it
                mov old9h[2],es
                mov ax,2509h                    ;then reset it
                mov dx,offset kbint
                int 21h
                pop es
                assume es:code
;
;Determine whether video is color or monochrome.
;
video:          push ds                         ;get address of CRT controller
                mov ax,bios_data
                mov ds,ax
                assume ds:bios_data
                mov ax,addr_6845
                mov crtc_addr,ax                ;save it
                pop ds
                assume ds:code
                test ax,40h                     ;is bit 6 of CRTC address set?
                jnz more_video                  ;yes, then it's a color adapter
                inc mode                        ;no, then it's monochrome
                mov video_segment,0B000h        ;modify attributes for monochrome
                mov attribute,7
                mov menu_attr,7
;
;Determine number of display columns, screen color, and video page number.
;
more_video:     mov ah,15                       ;get number of columns and page
                int 10h
                mov columns,ah
                xor ah,ah
                mov lcolumns,ax                 ;store number of columns
                mov linelength,ax               ;store line length in bytes
                shl linelength,1
                dec al                          ;store number of columns - 1
                mov columns,al
                mov cl,75                       ;determine number of bytes
                sub cl,al                       ;  from end of one line to
                shl cl,1                        ;  beginning of next
                xor ch,ch
                mov delta,cx
                cmp ax,79                       ;adjust if more than 80 columns
                jna no_adjust                   ;  are currently displayed
                mov columns,79
                mov lcolumns,80
                mov delta,0
no_adjust:      mov ah,8                        ;read current attribute
                int 10h
                mov doscolor,ah                 ;store it for use upon exit
                or bh,bh                        ;make sure page zero is active
                je clrscr
                mov ax,0500h                    ;activate it if it's not
                int 10h
;
;Clear the screen or write data read from screen file to video memory.
;
clrscr:         cmp byte ptr ds:[81h],0         ;was a data file read?
                jne show_file                   ;yes, then display contents
                mov bh,attribute                ;no, then clear the screen
                call ClearScreen
                jmp short getkey                ;leave starting screen blank
show_file:      call ShowFile
;
;Solicit keystrokes and process non-extended keycodes.
;
getkey:         call ReadKey                    ;get a keystroke
                or al,al                        ;branch on entry of extended code
                je excode
                cmp al,0E0h
                je excode
                cmp al,8                        ;BACKSPACE key?
                jne enter
                cs dl,di                        ;currently at left edge of screen?
                je getkey                       ;yes, then ignore it
                call backspace                  ;delete last character
                jmp short getkey                ;return for more
enter:          cmp al,13                       ;ENTER key?
                jne escape
                mov ah,2                        ;advance cursor to next line
                xor bh,bh
                inc dh
                cmp dh,25                       ;wrap around if necessary
                jne nowrap
                sub dh,dh
nowrap:         sub dl,dl
                int 10h
                jmp short getkey                ;return for more
escape:         cmp al,27                       ;ESC key?
                jne charkey
                mov blocksw,0FFFFh              ;reset block indicator
                jmp short getkey                ;return for more
charkey:        cmp al,32                       ;character key?
                jb getkey                       ;no, then ignore it
                call WriteChar                  ;yes, then process it
                jmp short getkey                ;return for more
;
;Process an extended keycode.
;
excode:         mov al,ah                       ;transfer keycode to AL
                mov di,offset key_table         ;point DI to keycode table
                mov cx,25                       ;25 keycodes to check
                repne scasb                     ;scan table for current keycode
                jne getkey                      ;return if keycode not found
                mov bx,cx                       ;move index to BX
pcall:          shl bx,1                            ;double it
                call cs:[offset jump_table+bx]      ;call handling routine
                mov ah,3                            ;get cursor position
                xor bh,bh
                int 10h
                jmp short getkey                    ;return for more
main            endp

;-----------------------------------------------------------------------------
;ShowFile displays a 4000-byte block indexed by DATA_SEGMENT and BUFFERPTR.
;-----------------------------------------------------------------------------
ShowFile        proc near
                mov ax,4000                     ;find starting buffer address
                mov bl,bufferptr
                xor bh,bh
                mul bx
                mov si,ax                       ;transfer it to SI
                push ds                         ;point DS to data segment
                assume ds:nothing
                mov ds,data_segment
                xor ds,ds                       ;set DX for home cursor position
                mov cx,25                       ;25 display lines
show1:          push cx
                mov cx,lcolumns                 ;number of display columns
show2:          push cx
                mov ah,2                        ;position the cursor
                int 10h
                lodsw                           ;get one C/A pair
                mov bl,ah                       ;transfer attribute to BL
                mov ah,9                        ;display character and attribute
                mov cx,1
                int 10h
                inc di                          ;advance cursor
                pop cx
                loop show2                      ;loop until this line is done
                inc dh                          ;home cursor to start of next line
                xor di,di
                add si,delta                    ;adjust SI for other than 80 cols
                pop cx
                loop show1                      ;loop until 25 lines are done
                pop dx                          ;restore DX
                assume ds:code
                mov ah,2                        ;home the cursor
                xor ds,ds
                int 10h
                ret                             ;and exit
ShowFile        endp
```

(PAINT.ASM continues)

```
;-----------------------------------------------------------------------
;ReadKey reads a keypress.
;Exit:  AX - keycode
;-----------------------------------------------------------------------
ReadKey         proc near
                mov ah,kbcode                   ;get function code
                inc ah
                int 16h                         ;check buffer status
                jne read                        ;branch if a keycode is ready
                int 28h                         ;generate interrupt 28h
                jmp short ReadKey               ;enter pulling loop again
read:           mov ah,kbcode                   ;read key
                int 16h
                ret                             ;and exit
ReadKey         endp

;-----------------------------------------------------------------------
;ClearScreen clears the 25-line viewing area and homes the cursor.
;Entry:  BH - attribute
;-----------------------------------------------------------------------
ClearScreen     proc near
                mov ax,0600h                    ;clear screen with function 0
                xor cx,cx
                mov dh,24
                mov dl,columns
                int 10h
                mov ah,2                        ;home the cursor
                xor dx,dx
                xor bh,bh
                int 10h
                ret
ClearScreen     endp

;-----------------------------------------------------------------------
;HELP presents a help line denoting function key assignments.
;-----------------------------------------------------------------------
help            proc near
                mov si,offset help_text         ;display help text
                call MenuLine
help1:          call readkey                    ;wait for a keypress
                call RestoreLine                ;erase the help line
                ret
help            endp

;-----------------------------------------------------------------------
;QUIT exits the application.
;-----------------------------------------------------------------------
quit            proc near
                mov si,offset quit_text         ;display menu line
                call MenuLine
quit1:          call ReadKey                    ;get a keypress
                and al,0DFh                     ;capitalize response
                cmp al,'Y'                      ;was the response 'Yes?'
                je quit2                        ;yes, then exit
                cmp al,'N'                      ;was the response 'No?'
                je quit4                        ;yes, then return to application
                cmp al,27                       ;ESC key?
                je quit4                        ;yes, then return to application
                jmp short quit1                 ;get another keypress
quit2:          mov bh,dosColor                 ;clear screen before exit
                call ClearScreen
                mov ah,1                        ;restore the cursor
                mov cx,cursor_mode
                int 10h
                cmp kbcode,10h                  ;skip ahead if extended BIOS
                je quit3
                xor ax,ax                       ;restore the interrupt 9 vector
                mov es,ax
                cli
                mov ax,old9h
                mov es:[24h],ax
                mov ax,old9h[2]
                mov es:[26h],ax
                sti
quit2:          add sp,4                        ;clean up the stack
                mov ah,9
                mov dx,offset copyright
                int 21h
                mov ax,4C00h                    ;terminate
                int 21h
quit4:          call RestoreLine                ;restore save line
                ret                             ;return to application
quit            endp

;-----------------------------------------------------------------------
;SAVE saves the current screen to disk.
;-----------------------------------------------------------------------
save            proc near
                mov si,offset save_text         ;display save line
                call MenuLine
                mov ah,1                        ;display cursor
                mov cx,cursor_mode
                int 10h
getname:        mov si,fileptr                  ;read filespec from keyboard
                mov di,si
                mov ci,70
                mov dx,1000h
                call ReadString
                or ci,ci                        ;stop if nothing was entered
                jne save_file
                call RestoreLine
                ret
save_file:      mov ah,3Ch                      ;open the file for writing
                xor cx,cx
                mov dx,fileptr
                int 21h
                jc save_error                   ;jump on error
                push ax                         ;save file handle
                call RestoreLine                ;restore menu line
                mov ah,3                        ;read and save cursor position
                xor bh,bh
                int 10h
                push dx
                call PutVideo                   ;copy video to data buffer
                mov ah,2                        ;reset cursor
                pop dx
                int 10h
                mov ax,4000                     ;write data to disk
                mov bl,maxpage
                inc bl
                xor bh,bh
                mul bx
                mov cx,ax
                mov ah,40h
                pop bx
                push ds
                mov dx,data_segment
                assume ds:nothing
                mov ds,dx
                int 21h
                pop ds
                assume ds:code
                mov ah,3Eh                      ;close the file
                int 21h
                ret
;
;An error was encountered opening the file.  Resolicit the filespec.
;
save_error:     mov ax,0E07h                    ;beep
                int 10h
                mov ah,2                        ;reset cursor
                mov dx,1009h
                xor bh,bh
                int 10h
                jmp getname                     ;solicit filespec again
save            endp

;-----------------------------------------------------------------------
;PutVideo writes the current video page to the data buffer.
;-----------------------------------------------------------------------
PutVideo        proc near
                push es                         ;point ES:DI to buffer
                mov ax,data_segment
                assume es:nothing
                mov ax,4000
                mov bl,bufferptr
                xor bh,bh
                mul bx
                mov di,ax
                xor dx,dx
                mov cx,25                       ;copy contents a line at a time
put2:           push cx
                mov cx,icolumns
put2:           mov ah,2
                int 10h
                mov ah,8
                int 10h
                stosw
                inc di
                loop put3
                add di,dalte                    ;adjust for other than 80 columns
                inc dh
                xor dl,di
                pop cx
                loop put2
                pop es                          ;restore ES and exit
                assume es:code
                ret
PutVideo        endp

;-----------------------------------------------------------------------
;BLOCK function allows screen regions to be cleared or painted.
;-----------------------------------------------------------------------
bwidth          db ?                            ;block width in columns
firstcol        dh ?                            ;starting column number of block
c_loc           dw ?                            ;cursor position

binch           proc near
                cmp blockxy,0FFFFh              ;first corner?
                jne block1                      ;no, then branch
                mov blockxy,dx                  ;yes, then save cursor position
                ret                             ;and exit
block1:         mov cx,binckxy                  ;retrieve opposite corner location
                cmp cx,dx                       ;are CX and DX the same?
                jne notfull                     ;no, then branch
                xor cx,cx                       ;yes, then indicate full screen
                mov dh,24
                mov dl,columns
                jmp short block3
notfull:        cmp cl,di                       ;swap if necessary
                jbe block2
                xchg cl,di
block2:         cmp ch,dh
                jbe block2
                xchg ch,dh
binch3:         push cx                         ;save binch parameters
                push dx
                mov si,offset binch_text        ;display menu line
                call MenuLine
;
;Binch corners are recorded.  Get menu option and act accordingly.
;
block4:         call ReadKey                    ;get response
                cmp al,27                       ;ESC key?
                jne binch5
                mov binckxy,0FFFFh              ;reset block definition
                call RestoreLine                ;restore menu line
```

(PAINT.ASM continues)

```
                pop dx                          ;clean up the stack and exit
                pop cx
                ret
;
;Clear the indicated region if menu option '1' was selected.
;
block5:         cmp al,'1'                      ;clear region?
                jne block6
                call RestoreLine                ;restore last line
                pop dx                          ;retrieve block coordinates
                pop cx
                mov ax,0600h                    ;yes, then clear contents
                mov bh,attribute
                int 10h
                mov blockxy,0FFFFh              ;reset block function
                ret
;
;Paint the indicated region if menu option '2' was selected.
;
block6:         cmp al,'2'                      ;paint region?
                jne block4
                call RestoreLine                ;restore menu line
                mov ah,3                        ;get cursor position
                xor bh,bh
                int 10h
                mov c_loc,dx                    ;save it
                pop cx                          ;retrieve and swap parameters
                pop dx
                mov firstcol,dl                 ;save starting column number
                sub cl,dl                       ;determine block width
                inc cl
                mov bwidth,cl
                sub ch,dh                       ;then block height
                inc ch
                mov cl,ch
                xor ch,ch
block7:         push cx                         ;scan region and set attributes
                mov cl,bwidth
                xor ch,ch
block8:         push cx
                mov ah,2                        ;position cursor
                int 10h
                call SetAttribute               ;set current attribute
                inc dl                          ;advance to next column
                pop cx
                loop block8                     ;loop until this line is complete
                inc dh                          ;advance to next row
                mov dl,firstcol
                pop cx
                loop block7                     ;loop until all lines are done
                mov ah,2                        ;restore cursor position
                mov dx,c_loc
                int 10h
                mov blockxy,0FFFFh              ;reset block function
                ret
block           endp

;-----------------------------------------------------------------------
;Box routines process presses of Alt-Up, Down, Right, and Left.
;-----------------------------------------------------------------------
BoxUp           proc near
                or dh,dh                        ;top line?
                jz boxup1                       ;yes, then ignore keypress
                mov al,7                        ;generate default code
                mul graphics
                add al,178
                mov bx,dx                       ;define next cursor location
                dec bh
                mov boxid,18                    ;bias box code
                call DrawChars                  ;draw box characters
boxup1:         ret
BoxUp           endp

BoxDown         proc near
                cmp dh,24                       ;bottom line?
                je boxdn1                       ;yes, then ignore keypress
                mov al,7                        ;generate default code
                mul graphics
                add al,178
                mov bx,dx                       ;define next cursor location
                inc bh
                mov boxid,1                     ;bias box code
                call DrawChars                  ;draw box characters
boxdn1:         ret
BoxDown         endp

BoxLeft         proc near
                or dl,dl                        ;left edge of screen?
                je boxlf1                       ;yes, then ignore keypress
                mov al,6                        ;generate default code
                mul graphics
                add al,186
                mov bx,dx                       ;define next cursor location
                dec bl
                mov boxid,4                     ;bias box code
                call DrawChars                  ;draw box characters
boxlf1:         ret
BoxLeft         endp

BoxRight        proc near
                cmp dl,columns                  ;right edge of screen?
                jz boxrt1                       ;yes, then ignore keypress
                mov al,6                        ;generate default code
                mul graphics
                add al,186
                mov bx,dx                       ;define next cursor location
                inc bl
                mov boxid,64                    ;bias box code
                call ncwChars                   ;draw box characters
boxrt1:         ret
BoxRight        endp

;-----------------------------------------------------------------------
;ncwChars is called by the directional box routines to draw box characters.
;Entry:  AL = default box character
;        BX = next cursor position
;-----------------------------------------------------------------------
DrawChars       proc near
                mov defchar,al                  ;store default code
                push bx                         ;save next cursor location
                cmp graphics,0                  ;adjust BOXID if double line
                je drawc1
                shl boxid,1
drawc1:         call DrawBox                    ;draw character in current cell
                mov ah,2                        ;move cursor
                pop dx
                xor bh,bh
                int 10h
                mov boxid,0                     ;reset box code
                call DrawBox                    ;draw next box character
                ret
DrawChars       endp

;-----------------------------------------------------------------------
;DrawBox draws the appropriate box character at the current cursor position.
;-----------------------------------------------------------------------
DrawBox         proc near
                cmp graphics,1                  ;branch if line drawing characters
                jne db1                         ;  are selected
                mov al,graphics                 ;form character code
                sub al,2
                mov bx,offset box_table
                xlat box_table
                jmp short db3                   ;display character and exit
db1:            call GetEnv                     ;determine character code
                mov al,boxid                    ;transfer to AL
                mov cl,4                        ;generate desired character code
                rol al,cl
                mov cx,40                       ;see if character exists
                mov dl,offset qr_table
                repne scasb
                je db2                          ;display it if it does
                and al,maskval                  ;mask miand characters
                mov cx,40                       ;search again
                mov dl,offset qr_table
                repne scasb
                je db2
                mov al,defchar                  ;default to line character
                jmp short db3
db2:            mov al,218                      ;print the character
                sub al,cl
db3:            call DisplayChar
                ret
DrawBox         endp

;-----------------------------------------------------------------------
;SelectMode lets the user specify whether attributes will be inserted
;along with typed text.
;-----------------------------------------------------------------------
SelectMode      proc near
                mov al,offset mode_text         ;display menu line
                call MenuLine
sm1:            call ReadKey                    ;get response
                cmp al,27                       ;check for ESC key
                je sm2
                cmp al,'1'                      ;reject invalid entries
                jb sm1
                cmp al,'2'
                ja sm1
                sub al,'1'                      ;normalize entry
                mov write_mode,al               ;save it
sm2:            call RestoreLine                ;clean and exit
                ret
SelectMode      endp

;-----------------------------------------------------------------------
;SelectBox pops up the box character selection menu.
;-----------------------------------------------------------------------
SelectBox       proc near
                mov si,offset box_text          ;display menu line
                call MenuLine
sb1:            call ReadKey                    ;get response
                cmp al,27                       ;ESC key?
                je sb3                          ;yes, then exit
                cmp al,13                       ;ENTER?
                je sb3                          ;yes, then exit
                cmp al,'1'                      ;reject invalid responses
                jb sb1
                cmp al,'7'
                je sb1
                sub al,'1'                      ;normalize entry
                mov graphics,al                 ;then store it
                rc al,al                        ;set mask value
                jne sb2
                mov maskval,01010101b
                jmp short sb3
sb2:            cmp al,1
                jne sb3
                mov maskval,10101010b
sb3:            call RestoreLine                ;restore menu line
                ret
SelectBox       endp
```

(PAINT.ASM continues)

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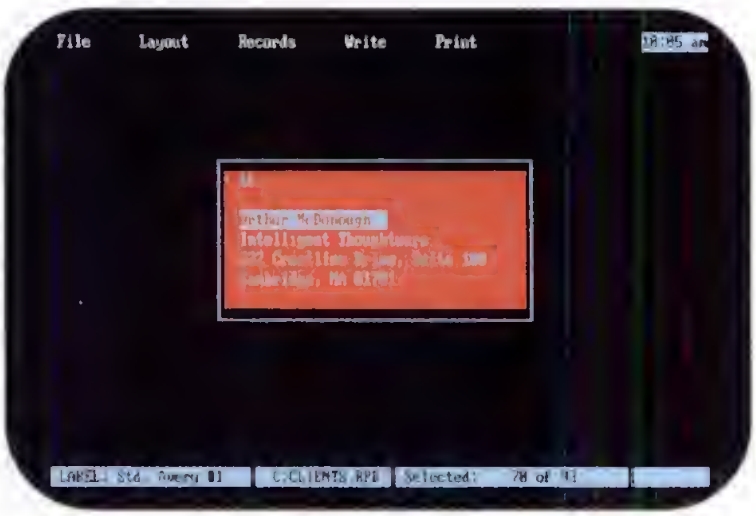

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CIRCLE 210 ON READER SERVICE CARD

```
;-------------------------------------------------------------------------
;examtettr pops up the screen attribute selection menu.
;-------------------------------------------------------------------------
tmpcol      db ?                        ;attribute under cursor

Selectattr  proc near
            mov ah,8                    ;get attribute under cursor
            xor bh,bh
            int 10h
            mov tmpcol,ah               ;save it
            cmp mode,0                  ;color video?
            je se0                      ;yes, then branch
;
;Display attribute menu for monochrome systems.
;
            mov si,offset mono_text     ;display menu line
            call MenuLine
mono1:      call ReadKey                ;get response
            or al,al                    ;function key F2?
            jne mono2
            cmp ah,60
            jne mono1
            mov ah,tmpcol               ;use attribute under cursor
            mov attribute,ah
            jmp short mono3             ;exit
mono2:      cmp al,27                   ;exit if ESC was pressed
            je mono3
            cmp al,'1'                  ;reject invalid responses
            jb mono1
            cmp al,'4'
            je mono1
            sub al,'1'                  ;normalize entry
            mov bx,offset mono_table    ;determine new attribute
            xlat mono_table
            mov attribute,al            ;save it
mono3:      call RestoreLine            ;restore line and exit
            ret
;
;Display attribute menu for color systems.
;
se0:        mov si,offset fore_text     ;display menu line
            call MenuLine
            mov ds,1800h                ;display colors
            xor bx,bx
se1:        mov ah,2
            int 10h
            mov ax,09DBh
            mov cx,2
            int 10h
            add dl,4
            inc bl
            test bl,10h
            je se1
se2:        call ReadKey                ;get foreground color response
            or al,al                    ;function key F2?
            jne notf1
            cmp ah,60
            jne se2
            mov ah,tmpcol               ;use attribute under cursor
            mov attribute,ah
            jmp short endselect         ;end exit
notf1:      cmp al,13                   ;ENTER key?
            je se4
            cmp al,27                   ;ESC?
            je endselect
            cmp al,'0'                  ;reject invalid responses
            jb se2
            cmp al,'9'
            jne se3
            and al,0Fh                  ;normalize entry
            cmp al,'A'
            jb se2
            cmp al,'F'
            je se3
            sub al,7
se3:        sub al,20h
            and attribute,0F0h          ;modify foreground color
            or attribute,al
se4:        mov si,offset back_text     ;display background colors
            mov ds,1800h
            mov bl,menu_attr
            call WriteLine
            mov ah,2
            mov dx,182ch
            int 10h
            mov ax,0920h
            mov cx,24
            int 10h
se5:        call ReadKey                ;get background color response
            cmp al,13
            je endselect
            cmp al,27
            je endselect
            cmp al,'0'
            jb se4
            cmp al,'7'
            je se4
            sub al,20h
            mov cl,4
            shl al,cl
            and attribute,0Fh           ;modify background color
            or attribute,al
endselect:  call RestoreLine            ;restore menu line
            ret
SelectAttr  endp

;-------------------------------------------------------------------------
;WriteChar processes a press of a character key.
;-------------------------------------------------------------------------
WriteChar   proc near
            cmp insert_flag,0           ;insert state on?
            je disp_char                ;no, then skip insert sequence
            mov cl,columns              ;calculate number of shifts
            sub cl,dl
            xor ch,ch
            jcxz disp_char
            push ax                     ;save character and position
            push ds
            call VideoAddr              ;calculate video address
            mov bx,cx                   ;determine starting address
            shl bx,1
            add si,bx
            mov di,si
            sub si,2
            push ds                     ;save DS and ES
            push es
            assume ds:nothing,es:nothing
            mov dx,video_segment
            mov es,video_segment
            std                         ;set DF temporarily
            mov dx,crtc_addr            ;get CRT Controller address
            add dx,6                    ;address status register
vsync:      in al,dx                    ;wait for vertical retrace
            test al,8
            je vwait
            cmp write_mode,0            ;push text and attributes?
            jne push_all                ;yes, then branch
write_loop: movsb                       ;shift text only
            dec si
            dec di
            loop write_loop
            jmp short shift_done
push_all:   rep movsw                   ;shift text and attributes
shift_done: cld                         ;restore DF
            pop es                      ;restore DS and ES
            pop ds
            assume ds:code,es:code
            pop dx                      ;retrieve character and position
            pop ax
disp_char:  call DisplayChar            ;display the character
            mov ah,2                    ;advance the cursor
            cmp dl,columns              ;prevent overrun
            je nomove
            inc dl
nomove:     int 10h
            ret
WriteChar   endp

;-------------------------------------------------------------------------
;VideoAddr calculates the page zero video buffer address that corresponds
;to the cursor coordinates held in CX.
;Entry:  DH,DL = cursor row and column | Exit:  SI = buffer offset
;-------------------------------------------------------------------------
VideoAddr   proc near
            mov ax,rowlength            ;row * 160
            mul dh
            shl di,1                    ;add column * 2
            xor dh,dh
            add ax,dx
            mov si,ax                   ;transfer to SI
            ret
VideoAddr   endp

;-------------------------------------------------------------------------
;INSERT processes a press of the INS key.
;-------------------------------------------------------------------------
insert      proc near
            xor insert_flag,1           ;toggle flag
            ret
insert      endp

;-------------------------------------------------------------------------
;UP processes a press of Cursor-Up  or Ctrl-Up.
;-------------------------------------------------------------------------
up          proc near
            or dh,dh                    ;currently on top row?
            je done                     ;yes, then ignore the keypress
            push ax                     ;save keycode
            cmp al,100                  ;paint cell if Ctrl is pressed
            jb upl
            call SetAttribute
upl:        dec dh                      ;move cursor up a row
set_cursor: mov ah,2
            xor bh,bh
            int 10h
            pop ax                      ;retrieve keycode
            cmp al,100                  ;reset cell if Ctrl is pressed
            jb done
            call SetAttribute
done:       ret
up          endp

;-------------------------------------------------------------------------
;LEFT processes a press of Cursor-Left or Ctrl-Left.
;-------------------------------------------------------------------------
left        proc near
            or dl,dl                    ;currently at left edge?
            je done                     ;yes, then ignore the keypress
            push ax                     ;save keycode
            cmp al,100                  ;paint cell if Ctrl is pressed
            jb lf1
            call setAttribute
lf1:        dec dl                      ;move cursor left one column
            jmp short set_cursor
left        endp
```

(PAINT.ASM continues)

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```
;-----------------------------------------------------------------------
;RIGHT processes a press of cursor-Right or Ctrl-Right.
;-----------------------------------------------------------------------
right           proc near
                cmp dl,columns                  ;currently at right border?
                je done                         ;yes, then ignore the keypress
                push ax                         ;save keycode
                cmp al,100                      ;point cell if Ctrl is pressed
                jb rt1
                call SetAttribute
rt1:            inc dl                          ;move cursor right one column
                jmp short set_cursor
right           endp

;-----------------------------------------------------------------------
;DOWN processes a press of Cursor-Down or Ctrl-Down.
;-----------------------------------------------------------------------
down            proc near
                cmp dh,24                       ;currently on bottom row?
                je done                         ;yes, then ignore the keypress
                push ax                         ;save keycode
                cmp al,100                      ;point cell if Ctrl is pressed
                jb dn1
                call SetAttribute
dn1:            inc dh                          ;move cursor down a row
                jmp short set_cursor
down            endp

;-----------------------------------------------------------------------
;HOME processes a press of the HOME key.
;-----------------------------------------------------------------------
home            proc near
                xor dl,dl                       ;set cursor to start of line
home1:          mov ah,2
                xor bh,bh
                int 10h
                ret
home            endp

;-----------------------------------------------------------------------
;ENDKEY processes a press of the END key.
;-----------------------------------------------------------------------
endkey          proc near
                mov dl,columns                  ;set cursor to end of line
                jmp home1
endkey          endp

;-----------------------------------------------------------------------
;PgUp and PgDn routines flip to the last/next page in the buffer.
;-----------------------------------------------------------------------
PgUp            proc near
                cmp maxpage,0                   ;ignore if there's only one page
                je nopress
                call PutVideo                   ;write current page to buffer
                dec bufferptr                   ;go back one page
                test bufferptr,80h              ;wrap around if necessary
                jz pg1
                mov al,maxpage
                mov bufferptr,ai
pg1:            call ShowFile                   ;display new page
nopress:        ret                             ;exit
PgUp            endp

PgDn            proc near
                cmp maxpage,0                   ;ignore if there's only one page
                je nopress
                call PutVideo
                inc bufferptr                   ;advance page pointer
                mov al,maxpage                  ;wrap if necessary
                cmp ai,bufferptr
                jae pg1
                mov bufferptr,0
                jmp short pg1
PgDn            endp

;-----------------------------------------------------------------------
;DisplayChar writes the character in AL to the current cursor position.
;-----------------------------------------------------------------------
DisplayChar     proc near
                mov ah,9
                cmp write_mode,0                ;write attribute also?
                jne dc1
                inc ah                          ;no, then change function number
dc1:            xor bh,bh
                mov bl,attribute
                mov cx,1
                int 10h
                ret
DisplayChar     endp

;-----------------------------------------------------------------------
;SetAttribute sets the attribute of the character under the cursor.
;-----------------------------------------------------------------------
SetAttribute    proc near
                mov ah,8                        ;get character
                xor bh,bh
                int 10h
                mov ah,9                        ;write character and attribute
                mov bl,attribute
                mov cx,1
                int 10h
                ret
SetAttribute    endp

;-----------------------------------------------------------------------
;SaveLine saves the contents of the menu line.
;-----------------------------------------------------------------------
cursor_mode     dw ?                            ;cursor mode
cursor_pos      dw ?                            ;cursor position

SaveLine        proc near
                mov ah,3                        ;get cursor position and shape
                xor bh,bh
                int 10h
                mov cursor_mode,cx              ;save cursor parameters
                mov cursor_pos,dx
                mov ah,1                        ;hide the cursor
                mov ch,20h
                int 10h
                mov dx,1000h                    ;set starting cursor position
                mov dl,offset data_buffer       ;point DI to save buffer
                mov cx,columns
sr1:            mov ah,2                        ;position the cursor
                int 10h
                mov ah,8                        ;read character and attribute
                int 10h
                stosw                           ;store them
                inc dl                          ;advance cursor to next column
                loop sr1                        ;loop until line is done
                ret
SaveLine        endp

;-----------------------------------------------------------------------
;RestoreLine restores the contents of the previously saved menu line.
;-----------------------------------------------------------------------
RestoreLine     proc near
                mov ah,1                        ;hide the cursor
                mov ch,20h
                int 10h
                xor bh,bh
                mov si,offset data_buffer       ;point SI to saved char/attr's
                mov cx,lcolumns
                mov dx,1000h                    ;initialize cursor position
rr1:            push cx
                mov ah,2                        ;position the cursor
                int 10h
                lodsw                           ;get character and attribute
                mov bl,ah                       ;transfer attribute to BL
                mov ah,9                        ;write character and attribute
                mov cx,1
                int 10h
                inc dl                          ;advance cursor to next column
                pop cx
                loop rr1                        ;loop until line is done
                mov ah,2                        ;restore cursor position and shape
                mov dx,cursor_pos
                int 10h
                mov ah,1
                mov cx,cursor_mode
                int 10h
                ret
RestoreLine     endp

;-----------------------------------------------------------------------
;GetEnv returns a value reflecting what lies on all four sides of the cursor.
;Entry:  DH,DL = cursor position         | Exit:  BOXID = neighbor code
;-----------------------------------------------------------------------
0_pos           label word
c_col           db ?                            ;cursor column
c_row           db ?                            ;cursor row

GetEnv          proc near
                mov c_pos,dx                    ;save cursor position
                call VideoAddr                  ;calculate video address
                mov dx,crtc_addr
                add dx,6
                push dx                         ;save DX
                mov dx,video_segment            ;point DS to video buffer
                assume ds:nothing
;
;Determine if what lies to the left affects the correct roll.
;
                sub si,2                        ;address cell to left
                cmp c_col,0                     ;at left edge of screen?
                je check2                       ;yes, then skip test
                test boxid,12                   ;branch if BOXID is missed
                jne check2
                mov ah,4
                call MakeCode                   ;generate BOXID code
;
;Then do the same for the right side.
;
check2:         add si,4
                mov si,columns
                cmp c_col,si
                je check4
                test boxid,192
                jne check4
                mov ah,64
                call MakeCode
;
;Check the character above the current cell.
;
check4:         sub si,linelength
                sub si,2
                cmp c_row,0
                je check6
                test boxid,48
                jne check6
                mov ah,16
                call MakeCode
;
;Finish up by checking the character below.
;
check6:         add si,linelength
                add si,linelength
```

(PAINT.ASM continues)

```
                cmp c_row,24
                je check0
                test boxid,3
                jnz check0
                mov ah,1
                call MakeCode
check0:         pop ds                          ;restore DS
                assume ds:code
                mov dx,c_pos                    ;restore DS
                ret                             ;and exit
GetEnv          endp

;-----------------------------------------------------------------------
;MakeCode modifies BOXID to reflect the character addressed by DS:SI.
;Entry:  DS:SI - character
;        AH    - test value
;        DX    - video status register
;-----------------------------------------------------------------------
MakeCode        proc near
                assume ds:nothing
                call GetChar                    ;retrieve character
                cmp al,178                      ;exit if not a graphics character
                jb make_exit
                cmp al,219
                je make_exit
                sub al,178                      ;check for single extension
                mov bx,offset gr_table
                xlat gr_table
                test al,ah
                je make1
                or boxid,ah
                jmp short make_exit
make1:          shl ah,1                        ;check for double extension
                test al,ah
                je make_exit
                or boxid,ah
make_exit:      ret
MakeCode        endp

;-----------------------------------------------------------------------
;GetChar returns the character addressed by DS:SI in AL.
;Entry:  DS:SI - character call          | Exit:  AL - character code
;        DX    - video status register   |
;-----------------------------------------------------------------------
GetChar         proc near
                assume ds:nothing
                in al,dx                        ;exit for horizontal scan
                test al,1
                jnz GetChar
                cli                             ;interrupts off
exit1:          in al,dx                        ;exit for next retrace
                test al,1
                je exit1
                mov al,[si]                     ;get the character
                sti                             ;interrupts on
                ret
GetChar         endp
```

```
                assume dx:code

;-----------------------------------------------------------------------
;MenuLine opens a menu line at the bottom of the screen.
;Entry:  DS:SI - text of menu line
;-----------------------------------------------------------------------
MenuLine        proc near
                push si                         ;save string address
                call SaveLine                   ;save current line contents
                mov ah,2                        ;position cursor on menu line
                xor bh,bh
                mov dx,1800h
                int 10h
                mov ax,0920h                    ;clear menu line
                mov bl,menu_attr
                mov cx,localmax
                int 10h
                pop si                          ;retrieve string address
                call WriteLine                  ;display text
                ret
MenuLine        endp

;-----------------------------------------------------------------------
;WriteLine displays a line of ASCIIZ text.
;Entry:  DS:SI - text string
;        DH,DL - cursor row and column
;-----------------------------------------------------------------------
WriteLine       proc near
                mov ah,2                        ;position the cursor
                xor bh,bh
                int 10h
write1:         lodsb                           ;get a character
                or al,al                        ;exit if it's zero
                je write2
                mov ah,10                       ;write it
                mov cx,1
                int 10h
                mov ah,2
                inc dl
                int 10h
                jmp write1                      ;loop back for more
write2:         ret
WriteLine       endp

;-----------------------------------------------------------------------
;ReadString reads a string of text from the keyboard.
;Entry:  CL    - maximum length
;        DH,DL - cursor position
;        DS:SI - default string
;        ES:DI - input buffer
;-----------------------------------------------------------------------
maxlen          db ?                            ;maximum accepted length

ReadString      proc near
                mov maxlen,cl                   ;store max length
                xor cl,cl                       ;initialize counter
```

(PAINT.ASM continues)

keypress, the program asks you to verify your intentions by answering "yes" or "no" before it returns control to the operating system.

YOUR VIDEO, YOUR COLOR Your PC may be in any text video mode when PAINT is invoked, with any number of rows and columns displayed. If there are more than 80 columns, PAINT partitions off the leftmost 80 and treats that region as a virtual 80- by 25-character screen. If fewer than 80 columns are displayed, you'll be limited to editing in the space represented on your screen. To maintain file compatibility with its companion utilities, however, PAINT always stores a screen image as a 4,000-byte file, regardless of the video mode or dimensions of the viewing area. One 80 by 25 screen comprises 4,000 bytes (2,000 cells with a character byte and an attribute byte for each). While PAINT can be used in other than 80-column modes, note that a 40-column display will trim off the rightmost portion of F2's foreground attribute menu. All 16 selections are still available, even though not all of them are visible.

As an extra touch, PAINT records the color of the screen beneath the cursor when it's invoked from the command line, then clears the screen back to that color when it's finished. For those users who go to lengths to add life to DOS's colorless interface, it's maddening to encounter application programs that mindlessly insist upon restoring the default white-on-black when execution is completed.

If you're working with a 101-key keyboard, you should also note that the Alt–arrow key combinations only work with the arrow keys on the dedicated cursor keypad. The extended BIOS included on these machines doesn't support the combination of the Alt key and the arrow keys on the numeric keypad.

MEMORY MANAGEMENT Michael J. Mefford's HELP utility will handle up to 14 screen images linked together into a single file, so PAINT must provide a buffer space of nearly a full 64KB for storage. A shortcut programmers often take [*Mefford did!—Ed.*] in the .COM environment is to use the dead space in the code segment between the end of the program code and the lower bounds of the stack. DOS locates the program's PSP and code at the bottom of the segment, while the stack is placed at the very top. But since one 64K segment constitutes 65,536 bytes and PAINT .COM itself is almost 3K in length, I was uncomfortable about reserving less than a full segment.

Thus, PAINT uses a more conventional method to acquire the needed memory. DOS function 48h is called to request 4,000 paragraphs from the memory pool. If it can't find 64,000 contiguous bytes to allocate, the operating system returns an error code and PAINT aborts with a "Not enough memory" message. And since a .COM file is initially allocated all of remaining memory when it is handed control by DOS, the request is preceded by a func-

```
                xor bh,bh
rs1:            lodsb                           ;input default string
                or al,al                        ;end of string?
                je rs2                          ;yes, then exit loop
                inc di                          ;advance buffer pointer
                inc cl                          ;increment count
                mov ah,14                       ;print the character
                int 10h
                jmp short rs1                   ;loop until zero byte is reached
rs2:            call ReadKey                    ;read the keyboard
                cmp al,8                        ;BACKSPACE key?
                jne rs3
                or cl,cl                        ;at beginning of line?
                je rs2                          ;yes, then ignore it
                mov ah,14                       ;move cursor back one space
                int 10h
                push cx                         ;delete the last character
                mov ax,0A20h
                mov cx,1
                int 10h
                pop cx
                dec cl                          ;decrement count and pointer
                dec di
                jmp short rs2                   ;return for more
rs3:            cmp al,13                       ;ENTER key?
                jne rs4                         ;no, then branch
                xor al,al                       ;mark end of string
                stosb
                ret                             ;done
rs4:            cmp al,27                       ;ESC key?
                jne rs5                         ;no, then branch
                xor cl,cl                       ;zero count
                mov al,cl                       ;place delimiter
                stosb
                ret
rs5:            cmp al,32                       ;ASCII code less than 32?
                jb rs2                          ;yes, then ignore it
                cmp cl,maxlen                   ;room for more?
                je rs2                          ;no, then ignore keypress
                stosb                           ;buffer the character
                inc cl                          ;increment count
                mov ah,14                       ;print the character
                int 10h
                jmp short rs2                   ;return for more
ReadString      endp

;-----------------------------------------------------------------------
;BACKSPACE backspaces over the last character.
;Entry:  DS,DL - cursor row and column
;-----------------------------------------------------------------------
backspace       proc near
                mov ah,2                        ;move cursor back one column
                dec dl
                xor bh,bh
                int 10h
                cmp insert_flag,0               ;is insert mode active?
                je be_exit                      ;no, then we're done
                push dx                         ;save cursor position
                call delete                     ;draw in everything to the right
                pop dx                          ;retrieve position
be_exit:        ret
backspace       endp

;-----------------------------------------------------------------------
;DELETE shifts everything right of the cursor one cell left.
;Entry:  DS,DL - cursor row and column
;-----------------------------------------------------------------------
delete          proc near
                mov cl,columns                  ;calculate number of shifts
                sub cl,dl
                xor ch,ch
                jcxz nodelete                   ;branch if there are none
                call VideoAddr                  ;calculate video address
                mov di,si
                add si,2
                push ds                         ;save DS and ES
                push es
                assume ds:nothing,es:nothing
                mov ds,video_segment
                mov es,video_segment
                mov dx,crtc_addr                ;get CRT Controller address
                add dx,6                        ;address status register
rwait:          in al,dx                        ;wait for vertical retrace
                test al,8
                jz rwait
                cmp write_mode,0                ;delete text and attribute?
                jne delete_all                  ;yes, then branch
del_loop:       movsb                           ;delete text only
                inc si
                inc di
                loop del_loop
                jmp short finish
delete_all:     rep movsw                       ;shift characters and attributes
finish:         mov byte ptr es:[di],32         ;blank final cell
                pop es                          ;restore DS and ES
                pop ds
                assume ds:code,es:code
                ret
nodelete:       mov ax,0A20h                    ;blank character under cursor
                xor bh,bh
                mov cx,1
                int 10h
                ret
delete          endp

data_buffer     label byte                      ;buffer for menu line

code            ends
                end begin
```

(PAINT.ASM ends)

tion 50h call to shrink the block of allocated memory to just the 64K needed for the code segment itself.

LINE DRAWING *WordPerfect* users have long enjoyed one of the most elegant ways ever implemented for drawing lines and boxes with the PC's upper-order graphics characters. Senior technical editor Robert Hummel and I conspired to go *WordPerfect* one better in ease of use and to create a fast and efficient algorithm for connecting intersecting lines with the appropriate graphics symbol.

In IBM's definition of the extended ASCII character set, 40 codes (numbered 179 through 218) provide a rich mix of single- and double-line graphics characters. Symbols are provided to connect any number of single or double lines that converge on a single cell, and to join most combinations of single and double lines coming together at a common point.

PAINT interprets a press of any of the four arrow keys in conjunction with the Alt key to mean that a line character should be placed in the current cell and the cursor forwarded in the indicated direction. Once the cursor is moved, another line character is drawn in the corresponding direction. When a line is drawn through an area void of other line symbols, choosing the proper character is as simple as selecting a horizontal character for right-left movement or a vertical character for up-down motion. But PAINT has to incorporate a certain amount of intelligence to recognize which character is required when one or more lines meet at perpendicular angles. Attacking the problem with brute force by installing a huge CMP tree to check the characters in surrounding cells is out of the question, since the number of possible permutations arising from the combination of 40 different characters taken 5 at a time is staggering.

To simplify the problem, PAINT incorporates a 40-byte table that contains a single descriptor byte for each graphics symbol. Each bit of the descriptor byte is assigned a meaning. If bit 0 of the descriptor is set, for instance, then the corresponding symbol has a single-line extension in its upper quadrant that will "connect" it to the cell above it. Bit 1 corresponds to the same extension, but with a double line. Following is a list of the bit assignments for the graphics symbol descriptor byte:

```
Bit 0 - Extension up (single line)
Bit 1 - Extension up (double line)
Bit 2 - Extension right (single line)
Bit 3 - Extension right (double line)
Bit 4 - Extension down (single line)
Bit 5 - Extension down (double line)
Bit 6 - Extension left (single line)
Bit 7 - Extension left (double line)
```

Thus a single byte can completely characterize any symbol and its extensions in all four directions. The character with ASCII code 191, for example, the upper-right corner of a single-line box (with extensions reaching both to the left and down), will have bits 4 and 6 set. Its descriptor value will be 80.

PAINT begins the process of drawing a line character by calling the routine GetEnv (for Get Environment) to return a one-byte value (using the descriptor format outlined above) that reflects what surrounds the current cell. If the characters above and to the left connect with single-line extensions to the current cell, for ex-

```
100 REM -- BASIC PROGRAM TO CREATE paint.COM
110 OPEN "paint.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  385
150    LINESUM = 0
155    PRINT ".";
160    FOR J = 1 TO 16
170       READ BYTE
180       CHECKSUM = CHECKSUM + BYTE
190       LINESUM = LINESUM + BYTE
200       IF (BYTE < 259) THEN LSET A$ = CHR$(BYTE)
210       PUT #1
220    NEXT J
230    READ LINECHECK
240    IF LINECHECK <> LINESUM THEN PRINT "Error in Line";200 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 314881 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    222,    222,      2,     88,     95,     73,     78,     84,   837
300 DATA     32,     49,     66,     48,     32,     48,     99,     41,   387
310 DATA     32,     49,     57,     56,     99,     32,     98,    109,   676
320 DATA    102,    102,     32,     97,    111,    109,    109,    117,   749
330 DATA    116,    105,     99,     57,    119,    105,    111,    116,   853
340 DATA    115,     32,     97,    111,     49,     12,     10,     88,   474
350 DATA     97,     22,     77,     57,    102,     57,    122,    105,   708
360 DATA    116,    107,     22,    254,     22,     74,    101,    102,   889
370 DATA    102,     32,     88,    116,    111,    115,    105,    115,   776
380 DATA    101,     13,     10,     39,     26,     12,     10,     78,   275
390 DATA    109,    108,    101,     32,    110,    111,    119,     22,   715
400 DATA    102,    111,    117,    110,    108,     13,     10,     28,   599
410 DATA     13,     10,     69,    114,    114,    111,    114,     32,   577
420 DATA    116,    101,     97,    100,    105,    110,    103,     22,   792
430 DATA    102,    105,    198,    101,     13,     10,     36,     13,   488
440 DATA     10,     78,    111,    119,     22,    101,    110,    111,   949
450 DATA    117,    103,    104,     32,    109,    101,    109,    111,   789
460 DATA    114,    121,     12,     10,     39,     10,    129,      0,   439
470 DATA      0,      0,      0,      0,      0,      0,      0,      0,     0
480 DATA      0,      0,      0,      0,      0,    255,    255,     21,   561
490 DATA      0,      0,      0,     65,     27,      0,    104,      0,   299
500 DATA      0,      0,      0,      0,      0,      0,      0,     89,    89
510 DATA    128,    105,    116,     22,    116,    111,     32,     68,   788
520 DATA     79,     83,     32,     48,     89,     67,     78,     61,   489
530 DATA     63,      0,     83,     57,    110,    101,     32,     97,   591
540 DATA    115,     50,     32,      0,     69,     45,    179,     32,   510
550 DATA     32,     58,     45,    106,     32,     32,     51,     45,   473
560 DATA    179,     32,     22,     52,     45,    177,     32,     32,   578
570 DATA     53,     45,    170,     32,     32,     54,     45,    219,   650
580 DATA     32,     32,     55,     65,     42,      0,     70,    111,   387
590 DATA    116,    101,    103,    114,    111,    117,    110,    100,   870
600 DATA     58,     32,     32,     40,     32,     32,     32,     69,   315
610 DATA     32,     32,     32,     50,     32,     32,     32,     51,   293
620 DATA     32,     32,     32,     52,     32,     32,     32,     53,   297
630 DATA     32,     32,     32,     54,     32,     32,     32,     55,   301
640 DATA     32,     32,     32,     59,     32,     32,     32,     57,   385
650 DATA     32,     32,     32,     95,     32,     12,     32,     66,   323
660 DATA     32,     32,     32,     67,     32,     32,     32,     68,   327
670 DATA     22,     32,     32,     99,     32,     32,     32,     70,   331
680 DATA      0,     99,     97,     99,    107,      0,     49,     45,   493
690 DATA     70,    111,    114,    109,     97,    100,     32,     32,   681
700 DATA     58,     45,     82,    101,    110,    101,    116,    115,   726
710 DATA    101,     32,     32,     51,     45,     66,    111,    108,   569
720 DATA    108,     32,     32,     52,     45,     85,    110,    100,   559
730 DATA    101,    114,    108,    105,    110,    101,      8,     49,   900
740 DATA     45,     67,    100,    101,     57,    116,     32,     32,   599
750 DATA     58,     45,     80,     97,    105,    110,    119,      9,   903
760 DATA     49,     45,     86,    101,    120,    119,     32,     79,   929
770 DATA    110,    108,    121,     32,     32,     58,     45,     84,   502
780 DATA    101,    120,    116,     32,     97,    110,    100,     32,   788
790 DATA     95,    116,    116,    114,    105,     98,    117,    119,   967
800 DATA    101,    115,      9,     78,     49,     65,     72,    101,   553
810 DATA    108,    112,     32,     32,     70,     58,     45,     95,   516
820 DATA    119,    119,    114,    105,     98,    117,    116,    101,   801
830 DATA     22,     32,     70,     51,     45,     70,    105,    110,   521
840 DATA    101,     32,     32,     70,     52,     45,     77,    111,   538
850 DATA    108,    101,     32,     32,     70,     53,     65,     96,   499
860 DATA    108,    111,     99,    107,     32,     32,     70,     54,   913
870 DATA     45,     83,     97,    116,    101,     32,     32,     70,   570
880 DATA     55,     45,     81,    117,    105,    119,      8,     81,   900
890 DATA     73,     99,     94,     93,     92,     91,     90,     59,   907
900 DATA    148,    187,    159,    152,    146,    118,    115,    141,  1141
910 DATA     83,     82,     79,     71,     88,     77,     79,     72,   615
920 DATA     17,     81,    145,     90,     99,    164,    192,     34,   777
930 DATA    190,    130,     96,    129,     88,      5,     65,     86,   723
940 DATA     21,     68,     85,     25,     38,     10,     40,    138,   425
950 DATA    198,     62,    136,    176,    137,     70,    152,    100,   975
960 DATA      9,      0,     26,     39,    182,    153,     69,     28,   615
970 DATA    179,    177,    170,    219,     42,      7,    112,     15,   929
980 DATA      1,     31,     10,     98,     10,     79,     10,     96,   292
990 DATA     10,    111,     10,    128,     10,     25,     10,    102,   670
1000 DATA    12,     31,     10,     98,     14,     79,     10,     96,   383
1010 DATA    10,    195,      7,    216,      7,    241,      7,    198,   863
1020 DATA     7,    227,      9,    199,      5,    141,      8,    111,   783
1030 DATA     8,    244,      9,     70,      9,    240,      5,    129,   705
1040 DATA    10,    157,     10,    251,     88,     83,    220,     96,   515
1050 DATA    90,     72,    119,     15,     90,     75,    116,     15,   533
1060 DATA    90,     77,    116,     11,     68,     88,    119,      7,   527
1070 DATA    51,     88,     49,    255,     46,    171,      1,    130,   836
1080 DATA   210,    188,      2,    205,     22,    198,      6,    110,   912
1090 DATA    22,    128,    251,     75,    110,    234,    128,    251,  1205
1100 DATA    77,    119,    225,    128,    195,     99,    128,    251,  1193
1110 DATA   141,    119,     11,    179,    145,    235,      7,    198,  1082
1120 DATA     8,    119,    213,    128,    195,     88,    228,     97,  1065
1130 DATA   130,    226,     32,    128,    238,     97,    138,    199,  1192
1140 DATA   238,     97,    208,    170,     32,    238,     32,    251,  1298
1150 DATA   138,    227,     58,    192,     82,     38,    197,     84,   978
1160 DATA     8,    142,    219,    258,    139,     38,     28,      8,   888
1170 DATA   139,    211,    131,    194,      2,     59,     22,    128,   888
1180 DATA     8,    117,      8,    139,     22,    128,      8,     59,   469
1190 DATA    22,     29,      8,    119,      9,    137,      7,    127,   491
1200 DATA    22,     29,      8,    251,     31,     98,     91,     88,   981
1210 DATA   207,    188,     74,    187,      8,     16,    385,     32,   982
1220 DATA   188,     72,    187,    198,     15,    285,     23,    115,   997
1230 DATA     5,    189,    119,      1,    225,     51,    192,    144,   984
1240 DATA     1,    252,    198,    129,      8,    172,     68,     32,   819
1250 DATA   110,    251,     98,     13,    117,      7,    198,      9,   798
1260 DATA   129,      8,      8,    225,     85,     78,    127,     54,   718
1270 DATA   163,      1,    130,     28,    128,      8,     58,    255,   766
1280 DATA   198,    135,    129,      8,      8,    186,      8,     91,   787
1290 DATA   139,    214,    285,     23,    115,     12,    186,     77,   981
1300 DATA     1,    188,      9,    285,     23,    184,      1,     79,   989
1310 DATA   285,     22,    129,    219,    188,     93,    185,      8,  1021
1320 DATA   258,     38,    142,     20,    144,      1,     51,    210,   850
1330 DATA   205,     23,     31,    115,      5,    189,     99,      1,   972
1340 DATA   235,    223,     11,    192,    117,      5,    199,     99,  1065
1350 DATA     1,    225,    214,     72,     51,    210,    187,    100,  1138
1360 DATA    15,    247,    242,    192,    158,      1,    188,     62,  1098
1370 DATA   285,     23,    188,      5,    185,    255,    255,    285,  1322
1380 DATA    23,    188,     19,    285,     22,     61,    255,    299,  1016
1390 DATA   116,     28,    198,      6,    141,      1,      8,      9,   459
1400 DATA   184,      9,     52,    205,     33,    127,     38,    173,   822
1410 DATA     1,    148,      8,    173,      1,    184,      9,     37,   551
1420 DATA   189,     91,      2,    285,     22,      7,     38,    184,   739
1430 DATA    66,      8,    142,    216,    161,     99,      8,     38,   728
1440 DATA   192,    155,      3,     31,    199,     84,      8,    117,   788
1450 DATA    28,    254,      8,    151,      1,    155,      9,    165,   882
1460 DATA     1,      8,    179,    198,      8,    159,      1,      7,   568
1470 DATA   198,      6,    194,      1,      7,    188,     15,    285,   776
1480 DATA    19,    128,    199,     58,    228,    192,    153,      1,   965
1490 DATA   163,    169,      3,    289,     28,    199,      1,    259,  1884
1500 DATA   288,    192,    152,      1,    177,     79,     62,    288,  1813
1510 DATA   288,    225,     58,    227,    137,     16,    197,      1,  1839
1520 DATA    98,     79,    110,     17,    198,      9,    152,      1,   931
1530 DATA    79,    199,      9,    153,      1,     88,      8,    199,   717
1540 DATA     9,    197,      1,      8,      8,    108,      8,    285,   567
1550 DATA    19,    136,     38,    146,      1,     18,    255,    116,   718
1560 DATA     5,    186,      8,      5,    285,     19,    128,     92,   905
1570 DATA   129,      8,      8,    117,      9,    138,     92,    159,   614
1580 DATA     1,    232,    193,      8,    235,      3,    232,     57,   553
1590 DATA     8,    232,    164,      8,     18,    152,    119,     61,   775
1600 DATA    98,    224,    119,     57,     98,      8,    117,      9,   951
1610 DATA    10,    210,    119,    237,    232,    122,      7,    235,  1169
1620 DATA   232,     98,     13,    117,     19,    188,      2,     58,   873
1630 DATA   255,    254,    198,    128,    254,     25,    117,      2,  1233
1640 DATA    58,    266,     58,    210,    285,     19,    225,    289,  1221
1650 DATA    98,     27,    117,      8,    199,      9,    157,      1,   575
1660 DATA   255,    255,    235,    197,     98,     32,    114,    193,  1361
1670 DATA   232,     87,      4,    235,    188,    138,    198,    191,  1271
1680 DATA   223,      2,    105,     25,      8,    262,    174,    117,   998
1690 DATA   176,    139,    217,    209,    227,     49,    255,    151,  1428
1700 DATA    41,      3,    188,      3,     58,    255,    285,     18,   753
1710 DATA   235,    159,    186,    198,     15,    138,     38,    149,  1078
1720 DATA     1,     58,    255,    267,    227,    139,    248,     38,  1189
1730 DATA    38,    162,     38,    144,      1,     51,    219,    185,   881
1740 DATA    25,      8,     81,     38,    139,     14,    153,      1,   451
1750 DATA    81,    188,      2,    285,     19,    173,    130,    220,  1015
1760 DATA   188,      9,    105,      1,      8,    285,     19,    256,   858
1770 DATA   194,     89,    229,    239,    254,    198,     58,    210,  1457
1780 DATA    38,      3,     54,    197,      1,     99,    229,    210,   799
1790 DATA    31,    188,      2,     51,    210,    285,     16,    185,   998
1800 DATA   138,     38,    141,      1,    254,    199,    285,     22,   995
1810 DATA   117,      6,    285,     68,    235,    242,    138,     38,  1019
1820 DATA   141,      1,    285,     22,    195,    184,      8,      9,   754
1830 DATA    51,    201,    182,     24,    138,     22,    153,      1,   771
1840 DATA   385,     19,    188,      2,     51,    210,     58,    255,   999
1850 DATA   285,     19,    199,    198,    199,      2,    232,     36,  1831
1860 DATA     9,    232,    206,    259,    232,     37,      5,    199,  1169
1870 DATA   198,    175,      1,    232,     23,      9,    232,    191,  1858
1880 DATA   255,     39,    223,     68,     89,    116,     18,     98,   849
1890 DATA    78,    116,     93,     98,     27,    119,     59,    235,   754
1900 DATA   237,    138,     82,    148,      1,    232,    188,    298,  1268
1910 DATA   188,      1,    139,     14,    228,     18,    285,     19,   793
1920 DATA   128,     82,    141,      1,     19,    118,     28,     51,   535
1930 DATA   192,    142,    192,    258,    191,    171,      1,     38,  1147
1940 DATA   183,     39,      8,    161,    173,      1,     38,    193,   735
1950 DATA    38,      8,    251,    131,    199,      4,    188,      9,   889
1960 DATA   189,      3,      1,    285,     33,    184,      8,     79,   988
1970 DATA   285,     22,    232,    207,      4,    195,    198,    196,  1298
1980 DATA     1,    232,    153,      5,    188,      1,    135,     16,   765
1990 DATA   238,     18,    285,     19,    139,     56,    162,      1,   795
2000 DATA   139,    256,    177,     78,    189,      9,     24,    232,  1891
2010 DATA   238,      9,     18,    281,    117,      4,    232,    171,   978
2020 DATA     4,    185,    188,     98,     51,    281,    138,     22,   852
2030 DATA   142,      1,    285,     33,    114,     52,     98,    232,   859
2040 DATA   154,      4,    188,      3,     58,    255,    285,     16,   897
2050 DATA    82,    232,     54,      8,    188,      2,     98,    285,   845
2060 DATA    16,    189,    168,     15,    138,     38,    158,      1,   959
```

(continues)

PAINT.BAS: *A BASIC program that will automatically create PAINT.COM.*

■ UTILITIES

```
2070 DATA 294, 395,  50, 255, 247, 227, 139, 200, 3567
2080 DATA 100,  84,  81,  30, 142,  30, 144,   1,  802
2090 DATA  51, 210, 205,  33,  31, 100,  62, 205,  977
2100 DATA  33, 199, 164,   7,  14, 205,  16, 100,  934
2110 DATA   2, 100,   0,  24,  50, 255, 205,  10,  747
2120 DATA 235, 154,   6, 142,   0, 144,   1, 104,  872
2130 DATA 140,  15, 130,  36, 140,   3,  90, 255,  708
2140 DATA 247, 227, 130, 240,  91, 210, 105,  25, 1332
2150 DATA   0,  81, 139,  14, 153,   3, 100,   2,  570
2160 DATA 205,  10, 100,   0, 209,  16, 171, 254, 1055
2170 DATA 194, 220, 243,   3,  62, 147,   1, 294, 1190
2180 DATA 100,  50, 210,  85, 226, 227,   7, 105, 1202
2190 DATA   0,   0,   0,   0, 121,  82, 197,   1,  351
2200 DATA 259, 117,   5, 127,  22, 157,   3, 195,  889
2210 DATA 139,  14, 157,   1,  59, 202, 117,  10,  699
2220 DATA  53, 201, 102,  24, 130,  22, 152,   1,  771
2230 DATA 235,  12,  50, 202, 110,   2, 134, 202,  903
2240 DATA  50, 230, 110,   2, 134, 230,  01,  02,  551
2250 DATA 190, 303,   2, 232, 231,   4, 232, 143, 1137
2260 DATA 254,  00,  27, 117,  12, 109,   0, 157,  022
2270 DATA   1, 255, 255, 232, 222,   2,  50,  05, 1147
2280 DATA 155,  60,  45, 117,  21, 232, 212,   3,  805
2290 DATA  50,  05, 104,   0,   0, 130,  62, 155,  720
2300 DATA   1, 205,  10, 150,   0, 157,   1, 259,  840
2310 DATA 255, 195,  40,  50, 117, 200, 232, 107, 1304
2320 DATA   2, 100,   3,  50, 259, 205,  16, 177,  849
2330 DATA  22, 242,   0,  09,  90, 130,  22, 241,  840
2340 DATA   4,  42, 202, 294, 193, 130,  14, 240, 1007
2350 DATA   0,  02, 230, 254, 107, 120, 205,  90, 1130
2360 DATA 237,  01, 130,  14, 240,   4,  90, 237, 1003
2170 DATA  01, 100,   2, 209,  14, 232,  74,   3,  793
2380 DATA 254, 104,  00, 220, 243, 254, 100, 130, 1500
2390 DATA  22, 241,   6,  00, 220, 227, 100,   2,  903
2400 DATA 339,  22, 242,   0, 205,  10, 199,   6,  835
2410 DATA 157,   1, 255, 255, 199,  10, 244, 110, 1235
2420 DATA  20, 176,   7, 246,  30, 100,   1,   4,  852
2430 DATA 179, 130, 210, 254, 207, 200,   4, 102, 1303
2440 DATA   3,  10, 232,  75,   0, 105, 120, 254,  905
2450 DATA  24, 110,  20, 170,   7, 244,  30, 160,  707
2460 DATA   1,   4, 179, 139, 210, 254, 109, 100, 1102
2470 DATA   0, 102,   3,   1, 232,  53,   0, 105,  650
2480 DATA  10, 210, 116,  20, 174,   5, 244,  30,  025
2490 DATA 160,   3,   4, 100, 139, 210, 254, 203, 1175
2500 DATA 150,   6, 162,   1,   4, 232,  20,   0,  631
2910 DATA 105,  50,  22, 152,   1, 116,  20, 176,  740
2520 DATA   5, 246,  30, 160,   1,   4, 196, 115,  703
2530 DATA 210, 256, 156, 150,   6, 162,   1,  64, 1000
2540 DATA 232,   1,   0, 195, 162, 101,   1,  03,  025
2990 DATA 120,  02, 160,   1,   0, 110,   4, 200,  679
2560 DATA  30, 102,   1, 232,  16,   0, 100,   2,  031
2570 DATA  90,  50, 255, 205,  14, 190,   4, 102,  902
2500 DATA   1,   0, 232,   1,   0, 195, 120,  02,  619
2590 DATA 100,   1,   1, 310,  11, 100, 100,   1,  612
2600 DATA  04,   2, 107,  32,   3, 019, 239,  43,  701
2610 DATA 232,  10,   3, 360, 160,   1, 177,   4,  749
2020 DATA 210, 152, 109,  40,   0, 151, 240,   2, 1040
2610 DATA 242, 174, 116,  15,  34,   6, 163,   1,  755
2640 DATA 109,  40,   0, 391, 200,   2, 202, 174, 1002
2650 DATA 116,   5, 160, 161,   1, 235,   0, 176,  050
2660 DATA 010,  42, 193, 232,  77,   2, 195, 190, 1109
2670 DATA 120,   2, 232, 152,   3, 232,  04, 253, 1050
2600 DATA  40,  27, 110,  12,  00,  09, 114, 205,  604
2690 DATA  60,  56, 119, 201,  44,  49, 162, 100,  073
2700 DATA   1, 232, 136,   2, 195, 190, 204,   3,  961
2710 DATA 232, 122,   3, 232,  30, 293,  00,  27,  903
2720 DATA 110,  37,  00,  33, 110,  33,  00,  65,  604
2730 DATA 110, 241,  00,  55, 119, 227,  40,  05,  515
2700 DATA 102, 100,   1,  10, 192, 117,   7, 160,  047
2790 DATA   6, 163,   1,  06, 239,   5,  00,   1,  940
2740 DATA 117,   5, 150,   6, 103,   1, 170, 232,  052
2770 DATA  02,   2, 199,   0, 100,   0,  50, 295,  772
2700 DATA 206,  16, 136,  30, 195,   0, 120,  42,  700
2790 DATA 151,   1,   0, 116,  93, 190,  62,   2,  979
2000 DATA 232,  90,   3, 232, 210, 292,  10, 192, 1109
2010 DATA 117,  10, 120, 252,  00, 117, 244, 130, 1071
2020 DATA  30, 199,   0, 136,  30, 169,   1, 235,  010
2030 DATA  21,  00,  27, 116,  17,  60,  49, 114,  064
2040 DATA 226,  00,  62, 115, 222,  06,  49, 107,  599
2050 DATA  37,   3, 219, 102, 169,   1, 232,  11,  020
2060 DATA   2, 195, 190, 230,   1, 232, 293,   2, 1113
2070 DATA 100,  14,  24,  51, 219, 100,   2, 209,  001
2000 DATA  10, 304, 219,   6, 105,   2,   0, 209,  020
2090 DATA  10, 120, 194,   6, 294, 165, 246, 199, 1032
2900 DATA  10, 110, 234, 232, 130, 252,  10, 192, 1190
2910 DATA 117,  33, 120, 252,  00, 117, 260, 130, 1071
2020 DATA  30, 195,   0, 136,  30, 159,   1, 235,  010
2930 DATA 101,  00,  13, 116,  35,  60,  27, 116,  520
2040 DATA  63,  00,  60, 110, 222,  60,  67, 110,  772
2950 DATA  12,  50, 223,  60,  05, 114, 212,  00,  702
2960 DATA  70, 115, 200,  04,   7,  44,  40, 120,  660
2570 DATA  30, 159,   1, 200,   0,   6, 159,   1,  612
2500 DATA 150,  57,   2, 106,   0,  24, 130,  30,  027
2990 DATA 164,   1, 232, 103,   2, 100,   2, 106,  550
3000 DATA  44,  24, 205,  16, 106,  22,   5, 105,  659
3010 DATA  30,   0, 205,  16, 232,  09, 262,  00,  000
3020 DATA  13, 316,  27,  00,  27, 110,  23,  60,  402
3030 DATA  00, 110, 213,  60,  65, 119, 209,  04,  042
3040 DATA  00, 177,   4, 210, 220, 120,  30, 199,  900
3050 DATA   1,  16,   0,   0, 169,   1, 232, 107,  529
3060 DATA   1, 195, 120,  62, 147,   1,   0, 116,  050
3070 DATA  74, 130,  14, 162,   1,  42, 202,  50,  073
3000 DATA 237, 227,  44,  00,  02, 232,  79,   0,  097
3090 DATA 135, 217, 209, 227,   2, 203, 139, 250, 1431
3100 DATA 131, 220,   2,  30,   0,  04, 142,  30,  626
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2110 DATA 109,   1,  40, 142,   0, 145,   1, 293,  770
3120 DATA  40, 135,  22, 155,   1, 131, 104,   0,  094
3130 DATA 234, 160,   0, 116, 291,  46, 120,  02, 1015
3140 DATA 140,   1,   0, 117,   7, 164,  70,  79,  934
3150 DATA 226, 251, 235,   2, 243, 165, 252,   7, 1301
3100 DATA  21,  00,  00, 232, 100,   0, 100,   2,  012
3170 DATA  50,  22, 152,   1, 110,   2, 254, 104,  709
3100 DATA 205,  10, 105, 101, 199,   1, 240, 230, 1223
3100 DATA 200, 226,  50, 240,   3, 104, 130, 240, 1306
3200 DATA 105, 120,  94, 147,   1,   1, 355,  10,  731
3210 DATA 240, 110,  24,  00,  00, 100, 116,   3,  743
3220 DATA 232, 147,   0, 254, 200, 100,   2,  50, 1001
3230 DATA 255, 205,  10,  00,  00, 100, 114,   3,  041
3240 DATA 232, 151,   0, 195,  10, 210, 110, 201, 1105
3290 DATA  00,  00, 100, 114,   3, 232, 130,   0,  727
3200 DATA 254, 202, 235, 225,  50,  22, 192,   1, 1140
3270 DATA 110, 223,  00,  60, 100, 114,   3, 232,  030
3200 DATA 120,   0, 254, 194, 235, 207, 120, 254, 3202
3290 DATA  24, 110, 216,  00,  00, 100, 134,   3,  713
3300 DATA 232, 103,   0, 254, 190, 235, 190,  50, 1202
3310 DATA 210, 100,   2,  50, 255, 205,  10, 105, 1113
3320 DATA 120,  22, 352,   1, 235, 243, 120,  02,  001
3230 DATA 150,   1,   0, 116,  23, 222,  50, 252,  024
3340 DATA 254,  14, 145,   1, 244,   0, 140,   1,  020
3350 DATA 120, 114,   0, 160, 190,   1, 102, 149,  072
3360 DATA   1, 232, 214, 200, 105, 120,  02, 150, 1232
3370 DATA   1,   0, 110, 240, 232,  10, 252, 254, 1122
3300 DATA   0, 169,   1, 160, 150,   1,  50,   0,  531
3390 DATA 140,   1, 115, 225, 190,   0, 140,   1,  040
3400 DATA   0, 235, 222, 100,   0, 120,  02, 140,  904
3410 DATA   1,   0, 117,   2, 254, 104,  50, 255,  075
3420 DATA 130,  30, 159,   1, 105,   1,   0, 205,  710
3430 DATA  10, 195, 100,   0,  50, 255, 205,  10,  025
3440 DATA 100,   5, 130,  30, 155,   1, 100,   1,  703
3490 DATA   0, 205,  10, 195,   0,   0,   0,   0,  410
3460 DATA 100,   2,  50, 295, 209,  10, 127,  14,  000
3470 DATA 220,  10, 137,  22, 230,  10, 100,   1,  010
3400 DATA 101,  32, 209,  10, 106,   0,  24, 101,  039
3490 DATA   4,  13, 139,  14, 153,   1, 100,   2,  904
3500 DATA 205,  14, 100,   0, 209,  10, 173, 294, 1055
3510 DATA 154, 226, 243, 105, 100,   1, 101,  32, 1252
3520 DATA 205,  16,  50, 295, 190,   4,  12, 139,  072
3530 DATA  14, 153,   1, 106,   0,  24,  01, 100,  039
3540 DATA   2, 205,  10, 173, 130, 220, 100,   9,  543
3550 DATA 105,   1,   0, 205,  10, 254, 104,  09,  544
3500 DATA 220, 230, 100,   2, 130,  22, 230,  10, 1045
3570 DATA 205,  14, 100,   3, 130,  14, 220,  10,  703
3500 DATA 209,  14, 195,   0,   0, 127,  22,  79,  090
3990 DATA  11, 232, 102, 250, 129,  22, 155,   1,  597
3000 DATA 131, 194,   6,  30, 142,  30, 105,   1,  099
3010 DATA 131, 220,   2,  30, 120,  62,  70,  11,  005
3020 DATA   0, 114,  13,  30, 240,   0, 102,   1,  502
3030 DATA  12, 117,   5, 100,   4, 232,  03,   0,  003
3660 DATA 131, 190,   4,  30, 140, 190,   1,  30,  700
3050 DATA  50,   0,  70,  11, 110,  13,  20, 240,  501
3060 DATA   6, 162,   1, 192, 117,   5, 100,  00,  727
3070 DATA 232,  66,   0,  30,  02,  54, 109,   1,  003
3600 DATA 121, 230,   2,  30, 120,  62,  76,  11,  006
3090 DATA   0, 116,  12,  30, 200,   0, 102,   1,  902
3700 DATA  40, 117,   5, 100,  10, 232,  37,   0,  035
3710 DATA  30,   3,  04, 169,   1,  30,   2,  54,  340
3720 DATA 169,   1,  30, 120,  02,  70,  11,  24,  509
3730 DATA 310,  12,  20, 200,   0, 102,   1,   2,  009
3700 DATA 117,   5, 100,   1, 232,   6,   0,  31,  572
3750 DATA 139,  22,  75,  11, 195, 232,  30,   0,  712
3740 DATA  00, 179, 114,  32,  60, 210, 319,  29,  012
3770 DATA  44, 175, 107, 240,   2,  30, 215, 132, 1065
3700 DATA 190, 110,   7,  30,   0,  30, 162,   1,  506
3790 DATA 235,  11, 200, 220, 132, 196, 116,   5, 1131
3000 DATA  30,   0,  30, 102,   1, 195, 250, 160,  006
3010 DATA   1, 117, 201, 250, 234, 160,   1, 110, 1100
3020 DATA 251, 130,   4, 291, 199,  06, 232, 219, 1372
3030 DATA 254, 100,   2,  50, 295, 106,   0,  24,  951
3000 DATA 205,  10, 300,  32,   9, 130,  30, 100,  770
3090 DATA   1, 126,  10, 153,   1, 296,  16,  96,  623
3040 DATA 232,   1,   0, 196, 100,   2,  50, 299,  615
3070 DATA 205,  16, 172,  10, 352, 116,  16, 100,  600
3000 DATA  10, 109,   1,   0, 205,  16, 100,   2,  696
3090 DATA 260, 160, 205,  10, 235, 234, 195,   0, 1335
3900 DATA 136,  14,  71,  12,  50, 201,  50, 256,  700
3910 DATA 372,  10, 192, 116,   5,  71, 250, 193, 1017
3920 DATA 100,  14, 205,  16, 235, 202, 232,  07, 1211
3930 DATA 269,  60,   0, 117,  23,  10, 201, 110,  706
3900 DATA 249, 100,  14, 209,  14,  01, 100,  32,  957
3990 DATA  10, 105,   1,   0, 205,  10,  09, 254,  700
3000 DATA 201,  75, 235, 220,  60,  13, 317,   4,  039
3070 DATA  90, 192, 170, 166,  60,  27, 117,   6,  017
2000 DATA  50, 201, 130, 163, 170, 195,  60,  32, 1039
3990 DATA 110, 200,  60,  16,  71,  12, 110, 160,  707
4000 DATA 170, 254, 152, 100,  10, 205,  10, 236, 1267
4010 DATA 109, 100,   2, 254, 202,  50, 255, 205, 1227
4020 DATA  16, 120,  02, 147,   1,   0, 316,   5,  475
4020 DATA  02, 222,   2,   0,  50, 155, 130,  14,  753
4000 DATA 162,   1,  02, 202,  90, 237, 227,  67,  000
4050 DATA 232,  72, 253, 139, 254, 131, 190,   2, 1201
4060 DATA  30,   6,  40, 142,  30, 165,   1,  46,  660
4070 DATA 142,   0, 165,   1,  06, 136,  22, 166,  670
4000 DATA   1, 121, 190,   0, 236, 100,   0, 116,  060
4090 DATA 251,  06, 120,  62, 100,   1,   0, 117,  763
4100 DATA   7, 164,  70,  71, 220, 261, 239,   2, 1020
4110 DATA 203, 166,  30, 190,   9,  32,   7,  31,  719
4120 DATA 199, 104,  32,  10,  50, 265, 106,   1,  512
4130 DATA   0, 205,  16, 195,   0,   0,   0,   0,  616
```

(PAINT.BAS ends)

PAINT BY MODEM

The programs published in *PC Magazine* can be downloaded by modem from the PC Magazine Interactive Reader Service. There is no charge for this service, but users are cautioned that these programs are copyright material and are made available only for individual, noncommercial use. You may make copies for others (including placement on noncommercial electronic bulletin boards), as long as no charge is involved. Making copies for any commercial purpose, however, is strictly prohibited.

The Eastern modem number for PC-IRS is (212) 696-0360. In the West, call (415) 598-9100. Set your modem and communications software to use 2400/1200/300 bps, 8 data bits, 1 stop bit, no parity. Files with a .COM, .EXE, or .ARC extension require use of the Xmodem error-checking protocol; files with .ASM or .BAS extensions can be downloaded using either regular ASCII or Xmodem.

If you use the Xmodem protocol, you can download PAINT .COM directly, saving typing or downloading either the .BAS or the .ASM version. PAINT.BAS, whether entered from the magazine at your keyboard or downloaded from PC-IRS, will automatically create PAINT.COM when run once in BASIC. PAINT .ASM, also listed both here and on PC-IRS, allows you to modify the program but requires you to use a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM PAINT;
LINK PAINT;
EXE2BIN PAINT PAINT.COM
```

Photocopy this page. Trim and hole-punch the copy and add it to your DOS manual.

PAINT Command

Jeff Prosise — **1988/No. 2 (Utilities)**

Purpose: Edits or creates custom help or reference screens that can be popped up over an application program or at the DOS prompt with HELP.COM (PC Lab Notes, January 12, 1988). Also provides full control of character and video attribute bytes and permits insertion of single-line, double-line, or pattern characters from the extended-ASCII PC text-graphics set.

Format: `PAINT [filespec]`

Remarks: The optional *filespec* is the filename (plus drive and path, if needed) of a help/reference screen previously saved for HELP.COM by means of the related CAPTURE program (PC Lab Notes, January 12, 1988). If *filespec* is omitted, PAINT permits creating and saving a new screen in the appropriate format. HELP files are 4,000-byte screen buffer images, and as many as 14 may be chained together for successive display. The PgUp and PgDn keys in PAINT move through multiple-screen files.

The Ins key toggles the PAINT editor between overstrike (the default) and insert modes. The Del key deletes the character under the cursor and closes up the text. In overstrike mode, the Backspace key moves the cursor left without moving any text characters on its right. In insert mode, the Backspace drags characters with it. The cursor can be moved anywhere within the viewing area by means of the cursor keys. Home and End move the cursor to the ends of the text line, and Enter performs the usual carriage return/line feed.

Function key F1 lists the menus presented by each function key, and Esc deselects any active menu. F4 toggles between Text-Only and Text-and-Attribute modes, which are also reflected in the operation of the Backspace and Del keys. Attributes are selected by number(s) after pressing F2, which presents 16 foreground and 8 background color choices (color systems) or normal, reverse, boldface, and underline (monochrome systems). By positioning the cursor on any displayed character and pressing F2 twice, that video attribute can be selected without using the menu numbers. Pressing Enter defaults to the current selection. Selected attributes remain in effect until changed.

PAINT Command

Jeff Prosise 1988/No. 2 (Utilities)

Small or irregular screen areas can be "painted" with the current attribute by holding down the Ctrl key and pressing the desired cursor arrow keys. Large screen areas may be defined by locating the cursor at one corner and pressing F5, then moving to the diagonal corner and pressing F5 again. A menu choice is then presented, either to clear the defined block of text characters or to paint them all with the current video attribute. Pressing F5 twice without moving the cursor defines the entire screen and presents the same choice.

Function key F3 permits selection of single- or double-line characters, patterns, or asterisks that are then written to the screen by holding down the Alt key and pressing the cursor arrows. Where lines cross, appropriate junction symbols are substituted. F6 asks for a filename under which the file is to be saved (it supplies the original filename as a default) and saves the file. Compensation is automatically applied to adjust for differences in display size. Pressing F7 returns to DOS.

Notes:

1. While PAINT is intended primarily for use with screens that use the HELP program, it can be used to advantage in prototyping screens for application programs and in the layout design of other pop-up windows.

2. PAINT is compatible both with traditional PCs and with the new PS/2 line.

MAKE YOUR CONTRIBUTION

Each issue we publish several assembly language utilities that help you work faster, smarter, or better.

Every Utilities column delivers a compact but useful program that supplements DOS. And PC Lab Notes regularly provides in-depth explanations of particular system-related topics, and includes valuable utilities that demonstrate how things work. These columns unlock the power of your computer by revealing bare-metal programming hints and techniques.

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If you are a serious .ASM programmer and would like to contribute to either the Utilities or PC Lab Notes column, please send us a letter with your name and address, a brief description of your programming abilities, and suggestions for programs you would like to write. A disk containing samples of previous .ASM programming is desirable but not required.

Send your submissions to:

Robert L. Hummel
Senior Technical Editor
PC Magazine
One Park Avenue
New York, NY 10016

ample, the byte labeled BOXID will return with the value 20 (bits 2 and 4 set). PAINT rotates the byte 4 bits left with an ROL instruction to generate the descriptor of the character needed to join the two lines. The resultant value of 65 describes the character with ASCII code 217, the lower-right corner of a box. PAINT scans the 40-byte table for the value 65, finds it, determines from its position in the table that it corresponds to ASCII 217, and inserts that character to form the union of the intersecting lines properly.

There are occasions when the symbol needed to fill a gap doesn't exist. This happens when an intersection is formed from a mixture of single and double lines. If PAINT scans the descriptor table and doesn't find a match, it retries the search with bits representing "foreign extensions" masked out. When the current line character is a single line, foreign extensions are the double lines that affect the current cell. When double lines are being drawn, single lines constitute foreign extensions. And when all else fails, PAINT falls back on the default horizontal or vertical character.

■ If the cursor is moving left, the first character drawn must extend into the left cell. PAINT effectively fools the GetEnv routine by placing a ghost in the next cell.

The final aspect of PAINT's line-drawing algorithm is its biasing of descriptor bytes. An Alt-arrow keypress generates a line character, moves the cursor, and then generates another line character. Before the initial symbol is drawn each time, PAINT "biases" the BOXID code that describes what lies around the current cell by setting the bit corresponding to the direction of cursor movement. If the cursor is moving left, for instance, the first character drawn must extend into the left cell, even though there may not be a character with a right-hand extension there initially. There will be, of course, as soon as the first symbol is drawn and the cursor is advanced. Thus, PAINT effectively fools the GetEnv routine by placing a ghost in the next cell.

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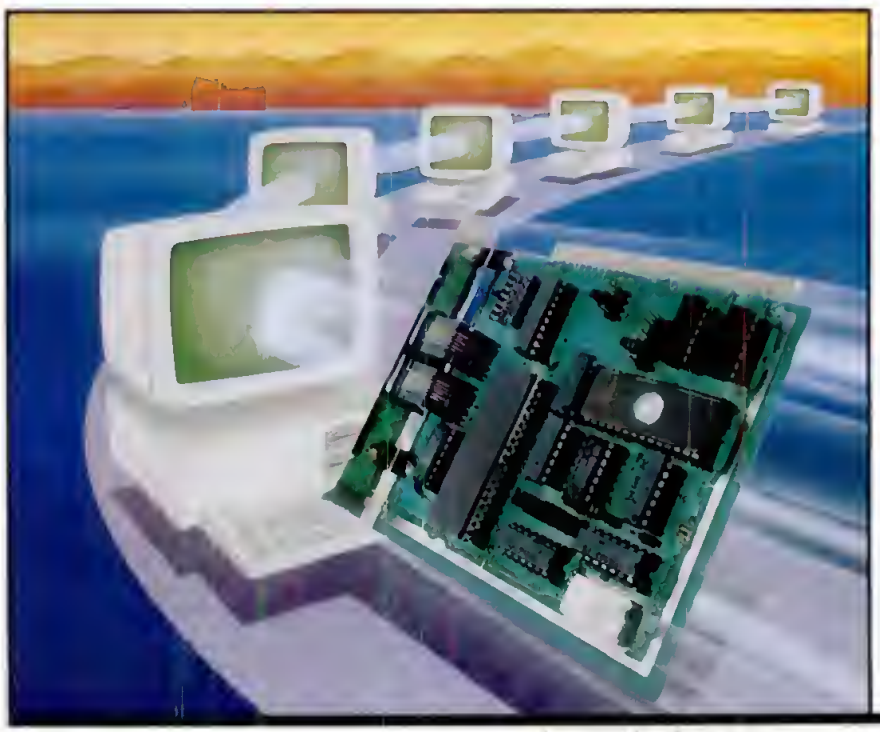

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■ UTILITIES

an important role in PAINT's user interface. But because of the limitations built into their BIOS, most machines in the installed base—including early ATs, most XTs, and all plain-vanilla PCs—recognize only two of the eight Ctrl-arrow/Alt-arrow key combinations: Ctrl-Left and Ctrl-Right. If PAINT finds that the BIOS of the computer it's running on doesn't support the extended keycodes, it installs its own interrupt 9 handler to take up where the BIOS leaves off.

The interrupt-handling code reads the keyboard data port (located at I/O address 60h) and, if it detects the press of an arrow key, checks the status of Ctrl and Alt. If either key is shifted, PAINT inserts a corresponding keycode manually into the keyboard buffer. The values of the newly generated codes match those officially assigned to the same key combinations in machines that have the newer, extended BIOS. Thus, in the body of the application, the same code can handle key interpretation without having to know whether the extended ASCII codes were presented by the BIOS or by its own internal handler.

One peculiarity of IBM's extended BIOS, however, is that the old (and standard) method of reading a keystroke with the sequence

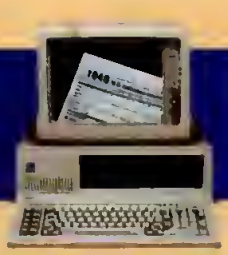
```
MOV AH,0
INT 16H
```

will not detect extended keycodes. Interrupt 16h must be called with AH set to 10h, instead. To accommodate this, PAINT uses the latter function number to solicit keystrokes on machines with an extended BIOS but uses function 0 with an older BIOS. Function 0 is adequate in that context because PAINT's own keyboard handler is interpreting the keypresses.

■ Most machines recognize only two of the eight Ctrl-arrow/Alt-arrow key combinations.

To determine whether or not extended keyboard functions are supported, PAINT uses a procedure outlined (loosely) in IBM's *BIOS Interface Technical Reference*. Interrupt 16h, function 5 is called to place the word FFFFh into the keyboard buffer, then function 10h is invoked to read it back. If AX returns with the value FFFFh, then by inference the extended keyboard functions are supported.

There is one final oddity about interrupt 16h, function 10h (extended keyboard read). On PS/2 machines, and possibly on other models equipped with an extended



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■ UTILITIES

BIOS, TSRs like *SideKick* can't find an opportunity to pop up while the BIOS is awaiting a keypress. The exact reason isn't clear, since BIOS listings for PS/2s haven't been published. The problem doesn't occur with function 0. PAINT works around the problem by polling the keyboard buffer for an entry and not call-

■ On PS/2 machines, TSRs like *SideKick* can't find an opportunity to pop up while the BIOS is awaiting a keypress.

ing function 10h until one is present, generating a series of interrupt 28h's in the meantime. *SideKick* uses interrupt 28h as a hook to gain control, disregarding an apparently-set INDOS flag.

FINAL POINTS There are other interesting programming details incorporated in PAINT that await those willing to scrutinize the program listing. If the interrupt 9 vector was hooked during initialization to enable an extended keyboard driver, for example, it must be replaced before the program terminates to prevent the interrupt chain from falling off into limbo.

The QUIT routine handles this chore by poking the saved vector back into its original place inside the interrupt vector table. QUIT also adds 4 to the stack pointer to clean off the two return-address words placed there when the last CALL instruction was executed. In reality, it's not necessary: DOS function 4Ch is smart enough to recognize the imbalance and make restitution itself. But since other operating systems aren't as forgiving (and since terminating with a RET instruction with stray words left on the stack would be disastrous), it's good programming practice *always* to undo any operation that directly affects the stack. PC

Jeff Prosise is a contributing editor of PC Magazine.

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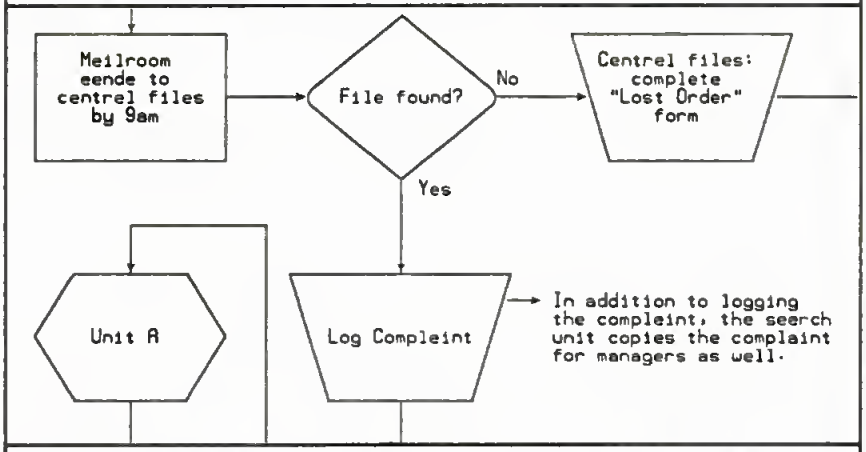

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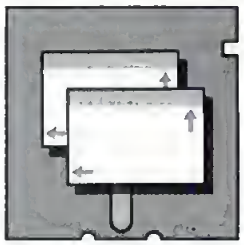
■ ENVIRONMENTS ■ CHARLES PETZOLD

OS/2 MEMORY MANAGEMENT



A look at the OS/2 memory-management functions, including sharing, and an illustrative short program that allocates a 1-megabyte memory block without bank-switching techniques.

The DOS 640K memory barrier has been a nuisance for years. It results primarily from the 1-megabyte physical address limit of the 8086 microprocessor and the 80286 running in real mode. In the original design of the PC, the lower 640K was reserved for random access memory used by the operating system and programs. The upper 384K was reserved for video and the ROM BIOS area.

When running under real mode, the only way to get around this limit is to use bank-switching techniques, the most notable of which is described by the Lotus/Intel/Microsoft Expanded Memory Specification (LIM EMS). The main disadvantage of bank-switched memory is that the applications themselves must continually make calls to the expanded memory manager to switch various banks in and out of the memory space. It is not what one would call a transparent system.

OS/2 runs the 80286 in protected mode and thus expands the physical address space to 16 megabytes. OS/2 also supports virtual memory, which is the use of a subsidiary storage device (such as a hard disk) to hold the overflow from real memory. In theory, 80286 virtual memory allows each protected-mode application to address 512 megabytes of its own memory and 512 megabytes of global memory. However, considering that OS/2 (like DOS) is limited to 32-megabyte hard disks, virtual memory under OS/2 is much less than the theoretical limit.

OS/2 has 17 functions specifically used for memory-management purposes. I'll describe most of these here to give you a taste of the subject. At the end of this column I'll show you a small program that allocates a megabyte of memory and treats it as a normal memory block without fussing with bank-switching and other nonsense.

Basically, protected mode gives programs elbow room. What I find most interesting about OS/2 memory allocation, however, is the exciting concept of sharing memory among applications. Most people have focused on the increased memory space and multitasking capabilities of OS/2. But I think that the real breakthroughs will come when applications begin to exploit the various interprocess communication features of OS/2. Shareable memory is part of that.

BASIC MEMORY ALLOCATION Let's go through the mechanics first. An OS/2 program can allocate a block of memory up to 64K by calling the DosAllocSeg function. In C, a call by your program to DosAllocSeg looks like this:

```
DosAllocSeg (Size, &Selector, Flags)
```

The size of the memory segment can range from 1 byte to 65,536 bytes. If you want the maximum 65,536 bytes, use 0 for the Size parameter. Normally, you set the Flags parameter in DosAllocSeg to 0. I'll discuss what the nonzero values do a little later in this column.

DosAllocSeg returns an error code if the memory allocation fails. Otherwise, DosAllocSeg returns 0 and stores the selector of the memory block at the address indicated by the second parameter to the function. A selector is the same as a segment address. It's called a selector in protected mode because it doesn't reference a physical address but rather an entry in a descriptor table.

In C you must convert the selector to a far pointer. Microsoft C supports the far keyword for pointers that include both a segment and offset address. The selector you get from DosAllocSeg is simply the upper 16 bits of a far pointer. For example, the C code to allocate a 32K memory block and obtain a far pointer to it looks like this:

```
unsigned int Selector ;
char far     *FarPtr ;

DosAllocSeg (32768, &Selector, 0) ;
FarPtr = (char far *)
     ((long)Selector << 16) ;
```

The last statement shifts the Selector variable 16 bits to the left and casts it to a far pointer. You can then use this FarPtr variable as if it were a normal pointer or a one-dimensional array of characters. For ex-

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ample, to set all the bytes of this memory block to zero, you can use this code:

```
for (i = 0 ; i < 32768 ; i++)
     FarPtr [i] = '\0' ;
```

In assembly language you probably want to define a double-word variable to hold the far address of the memory block. You then call DosAllocSeg to set the upper 16 bits of this variable to the selector:

```
FarAddr  dd  0

....

Push 32768
Push DS
Push Offset FarAddr + 2
Push 0
Call DOSALLOCSEG
```

As with all OS/2 function calls, the parameters to DosAllocSeg are pushed on the stack, starting with the size and then the address where OS/2 will store the selector.

After DosAllocSeg returns, you can zero out the memory block with this code:

```
Les DI, [FarPtr]
Mov CX, 32768
Sub AL, AL

Rep Stosb
```

OS/2 also includes a few other standard memory allocation functions. After a program allocates a block of memory, it can change the size by calling

```
DosReAllocSeg (NewSize, Selector) ;
```

A program can obtain the size of a memory block with

```
DosSizeSeg (Selector, &Size) ;
```

This last function was not documented in the initial release of the OS/2 Software Development Kit. The second parameter is a pointer to a 32-bit variable that will contain the size of the segment when the function returns.

When a program is finished using a block of memory, it can free it by a call to DosFreeSeg:

```
DosFreeSeg (Selector) ;
```

Any memory a program allocates but does not free will be freed by OS/2 when the program terminates.

I mentioned above that the Flags parameter for DosAllocSeg is normally set to 0, but it's the nonzero values that make DosAllocSeg more than just a traditional memory allocation function. Only the bottom three bits are used, as is shown in the table "DosAllocSeg's Active Bits."

SHARING MEMORY SEGMENTS Normally, a memory block is available only to the program that called the DosAllocSeg function. This is part of what protected mode is all about—memory allocated by one program can't be accessed by another program. The memory is protected from corruption.

However, there are often times when it is advantageous for two or more programs to share a block of memory. For example, a program might execute a child process to do some work while the parent process is doing something else. One way these programs can pass information to each other is through shared memory segments.

When the lowest flag bit is set in the DosAllocSeg function, the program that allocates the memory block can give another program access to it by calling DosGiveSeg thus:

```
DosGiveSeg (Selector, ProcessID,
      &NewSelector) ;
```

The first parameter is the selector returned from the DosAllocSeg function. The second parameter is the process ID of the program that is to receive access to the memory block. On return from DosGiveSeg, the NewSelector variable contains a selector appropriate for the program getting access to the memory block.

This is particularly suitable when a child process allocates a memory block and then gives its parent access to it. A child process can obtain the process ID of its parent from its information segment. Often DosGiveSeg is used for memory blocks that are transferred between programs by the use of queues. The DosGetSeg function is similar except that a program calls it to get access to a memory block that was allocated by another program.

In both cases there must be some other form of communication between the two programs other than the sharing of a common memory segment. The program getting access to a memory block through DosGetSeg or DosGiveSeg has to know the selector of a block originally obtained by another program. We'll examine an alternative to this shortly.

■ Setting the discardable flag in the DosAllocSeg call tells OS/2 simply to discard the memory segment if space is needed without saving the segment to disk.

DISCARDABLE MEMORY SEGMENTS The third flag bit in the DosAllocSeg call specifies that the memory block is discardable. Let's examine what we mean by this.

When OS/2 needs more memory than is currently available, it will normally save a memory segment to disk to free up space. It does this based on a least-recently-used algorithm. When the saved memory segment is needed again, OS/2 must reload it into memory, perhaps at the same time swapping another segment to disk.

This is the whole idea behind virtual memory: the hard disk becomes a temporary storage area when memory requirements of the various programs running under OS/2 exceed actual memory. The process is transparent to the programs running under OS/2.

A discardable memory segment is different. Setting the discardable flag in the DosAllocSeg call tells OS/2 simply to discard the memory segment if space is needed without saving the segment to disk. Whatever was stored there will be gone.

Why on earth would a program want to do that?

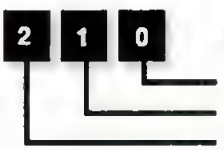
Suppose an OS/2 program used a large file of "help" information that it displayed on the screen at the user's request. The program could be cavalier about available memory and load the entire file into memory at once to quickly access it when needed. However, if there were not enough memory for this entire file, OS/2 would have to save some of it to disk and then access the disk a second time when the program actually needed it. This would slow down the system.

Alternatively, the program could be very cautious and courteous about available memory. Whenever the user wanted to see some help information, the program could allocate a block of memory, read part of the file, display it on the screen, and then free the memory block. But this is not ideal either because the program has to access the disk each time the user needs help.

A good compromise is to use discardable segments. The program can read part of the help file into a discardable segment but not free the segment. If the program needs to access that same memory block again, the segment may or may not be in memory. If it is, the program can use it. If not, the program loads it from disk again.

When a program needs to access a discardable segment, it calls DosLockSeg. This prevents the segment from being discarded until the program calls DosUnlockSeg. If DosLock returns an error code, then OS/2 has discarded the segment from memory and the program must recreate it.

DosAllocSeg's Active Bits



Bit	Meaning if bit is set
0	Shareable segment with DosGiveSeg
1	Shareable segment with DosGetSeg
2	Discardable segment

The DosAllocSeg Flags parameter is normally set to 0, but it's the nonzero values that make DosAllocSeg more than just a traditional memory allocation function.

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NAMED MEMORY SEGMENTS As we saw above, DosGetSeg and DosGiveSeg allow two or more programs to access the same memory block. The DosAllocShrSeg provides a somewhat different approach to memory sharing. A memory block allocated with DosAllocShrSeg is given a name when it is allocated. The name looks just like a filename except that it begins with a subdirectory-like name of SHAREMEM. You can use either forward slashes or backslashes to separate the SHAREMEM name and the memory block name. Figure 1 provides an example of the code used.

The name and extension of the memory block can be anything you want, but it must be preceded with SHAREMEM. It makes the most sense to set the name of the memory segment to be the same as the name of the program. Remember, however, that although it looks like a filename, it's not—it's the name of a memory block.

After the memory block is allocated, you can treat it just like the block allocated with DosAllocSeg. When you're finished with it, you free it with DosFreeSeg.

But here's the catch: During the time a named memory block is allocated, another memory block with the same name cannot be allocated by any other program running under OS/2. If another program tries to allocate a memory block with the same name, the DosAllocShrSeg call returns an error.

However, another process running under OS/2 can get access to the memory block by calling DosGetShrSeg like this:

```
DosGetShrSeg (MemName, &Selector) ;
```

The only thing the program needs is the name of the segment. DosGetShrSeg returns a selector to the memory block. Both programs can read from and write to the memory segment, and either program can free it. The block will actually be freed only when all programs that got access to it with DosAllocShrSeg and DosGetShrSeg have freed it.

This becomes most useful when the same program is run more than once in an OS/2 session. All the different copies of the program running at the same time can share a common block of memory.

An example from DOS will show where this might be used. As you know, DOS supports (more or less) the concept of RAM-resident programs. One problem with RAM-resident programs is that they often must determine whether they've already been loaded. There are several techniques for doing this. Perhaps the best is a brute-force search through memory looking for a previous copy.

Under OS/2, the named memory segment is a very easy and convenient alternative that provides other bonuses as well. Not only can the program determine that another copy is already running, but it can get easy access to a block of memory used by the first copy.

An example may help here. Let's suppose you have a keyboard macro program called KEYMACRO.EXE. This program reads in a set of keyboard macro commands stored in files with the extension KEY. When you run the program from the OS/2 command line the first time, you run it like this:

```
DETACH KEYMACRO SET1.KEY
```

KEYMACRO allocates a shared memory segment named

```
/SHARMEM/KEYMACRO.KEY
```

that reads the SET1.KEY file into the segment.

Suppose you then want to use your SET2.KEY set of keyboard macros instead. You run the command

```
DETACH KEYMACRO SET2.KEY
```

```
static char  MemName [] = "/SHAREMEM/MYMEMORY.DAT" ;
unsigned int Selector ;

....

DosAllocShrSeg (Size, MemName, &Selector) ;
```

Figure 1: *An example of how a C program allocates a named memory segment.*

This second copy of KEYMACRO.EXE also attempts to allocate a shared memory segment named

```
/SHAREMEM/KEYMACRO.KEY
```

The call fails. Aha! The program knows another copy is already running. So instead it gets access to the memory segment by calling DosGetShrSeg. It reads the SET2.KEY file into that memory block and then terminates. The original copy of KEYMACRO.EXE is now using the new set of macros.

■ Under OS/2, a program can allocate a "huge" memory block that is greater than 64K.

HUGE MEMORY BLOCKS All the memory blocks I've discussed so far are limited to 64K in size. This is, of course, a limitation of the segmented memory architecture of the 80286 microprocessor whether running in real mode or protected mode. Only when we get to 80386 protected mode is the 64K segment replaced by a nice, roomy 4-gigabyte segment.

However, there are techniques that a program can use to access a block of memory greater than 64K. If a program running under DOS allocates a contiguous block of memory greater than 64K, it can skip from the end of one segment to the start of another by incrementing the segment address by 4096.

Under OS/2, a program can also allocate a memory block that is greater than 64K. This is called a "huge" memory block. The function call (which would be entered on a single line) looks like this:

```
DosAllocHuge (NumFullSegs, LastSegBytes,
    &Selector, ShareFlag, MaxSegs)
```

The first parameter is the number of full 64K segments requested and the second parameter is the number of bytes in the last non-64K segment. For example, suppose you want to allocate 229,376 bytes of memory. You divide that by 65,536 to get

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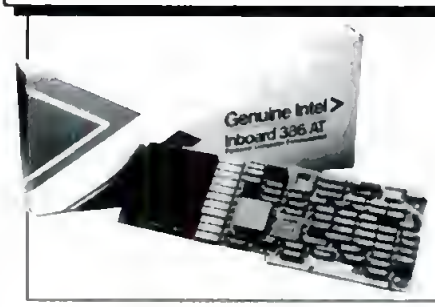

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```
/*-------------------------------------------------------
   PRIMES.C -- Programmed by Charles Petzold, 10/87
  -------------------------------------------------------*/

#define MAXPRIMES 1000000

#include <doscalls.h>
#include <stdio.h>

main ()
     {
     unsigned int HugeSelector ;
     char huge    *HugeArray ;
     long         Index, Index2 ;

     if (DOSALLOCHUGE ((unsigned int) (MAXPRIMES / 65536L),
                       (unsigned int) (MAXPRIMES % 65536L),
                             &HugeSelector, 0, 0))
          {
          printf ("PRIMES: Cannot allocate enough memory") ;
          return 1 ;
          }

     HugeArray = (char huge *) ((long) HugeSelector << 16) ;

     for (Index = 0 ; Index < MAXPRIMES ; Index++)
          HugeArray [Index] = '\0' ;

     for (Index = 2 ; Index < MAXPRIMES ; Index++)
          {
          if (HugeArray [Index] == '\0')
             {
             printf ("%8ld", Index) ;

             for (Index2 = 2 * Index ; Index2 < MAXPRIMES ; Index2 += Index)
                 HugeArray [Index2] = '\1' ;
             }
          }

     DOSFREESEG (HugeSelector) ;
     return 0 ;
     }
```

Figure 2: *A C program that calculates prime numbers from 1 to 1,000,000 and demonstrates the use of huge memory segments in OS/2.*

the number of full segments, which is 3 with 32,768 bytes left over. The first parameter is 3; the second is 32,768.

Perhaps this is a little clearer in hexadecimal: 229,376 bytes in hexadecimal is 38000H. The first parameter is 3; the second is 8000H.

You can later change the size of this segment with DosReAllocHuge. The last parameter in the original DosAllocHuge call is the maximum number of 64K segments you'll need in future DosReAllocHuge calls.

The DosAllocHuge function returns a selector that addresses the first 64K segment of the huge memory block. So the question now becomes: How do you get from one segment to the next? The segment increment of 4,096 used in DOS makes no sense under protected mode.

The information you need is obtained from another OS/2 function:

```
DosGetHugeShift (&ShiftCount) ;
```

When hopping from the end of one segment to the beginning of the next segment, you increment the segment address by the value 1 shifted left by the ShiftCount variable.

Under protected mode, DosGetHugeShift returns a 4. (But don't hard code this value because it could change in the future.) If you call DosGetHugeShift in a Family-API program and run it under real mode, the function returns a 12. Under real mode, 1 shifted left by 12 bits is 4096, which is the segment increment I mentioned above.

Under protected mode, the segment increment is 1 shifted left 4 bits, which is 16, or 10H. Typically, the DosAllocHuge returns a selector equal to 5FH. The next segments in the huge block are 6FH, 7FH, 8FH, and so on. (Remember that these are not physical addresses but rather offsets in a descriptor table.)

Why does DosGetHugeShift return a shift count rather than a segment address increment directly? In some cases, the shift count is easier to use. For example, suppose you want to access 163,840 bytes (28000H in hexadecimal) from the beginning of a huge block. You start with the far address that points to the beginning of the huge block and add 8000H to the offset. You use the shift count to shift the 2 left. Under real mode you get 2000H or 8192; under protected mode you get 20H or 32. Add that to the segment address.

Working with huge memory segments in a program is no great joy. You'll soon wish more than ever that OS/2 had been ready a couple of years ago so we could be using the 80386 version now.

But if you're programming in C, you have some help from the Microsoft C compiler. The compiler supports the huge memory block with the *huge* keyword. All the segment arithmetic is done for you.

To illustrate this, the PRIMES.C program shown in Figure 2 allocates a 1-megabyte huge memory block. This program calculates and displays all the prime numbers from 1 to 1,000,000.

I have not attempted to optimize this program for speed. In fact, I deliberately wrote the program so that it accesses the huge memory block as an array (rather than use C's more efficient pointer arithmetic) in order to clarify the structure. The program really shows how using a 1MB memory block in an OS/2 program can be remarkably simple.

Using the C compiler included with the OS/2 Software Development Kit, the program can be compiled and linked with the statement

```
cl -G2 primes.c
```

The program is quite sluggish when it begins running, and it takes about 20 seconds to display the first number. It soon picks up speed and finishes in under 9 minutes on an 8-MHz AT. (Without the screen output, it takes about 1½ minutes.)

Of course, under OS/2 you don't have to sit there and watch. You can do something else while PRIMES is running.

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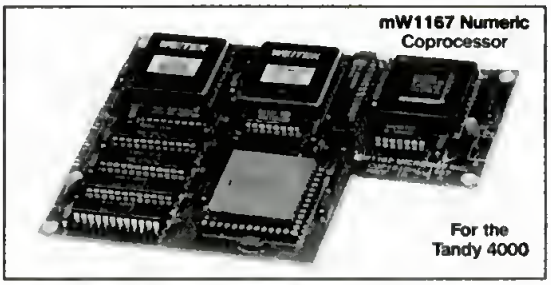

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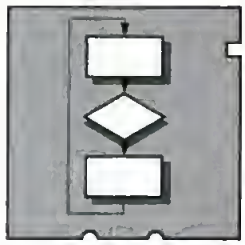
CHANGING THE MS-DOS ENVIRONMENT



While child programs can't change their parents' inheritance from DOS, here are routines in C and assembler that let parent programs affect their children's environmental outlook.

My last column discussed MS-DOS environment blocks, their history, and how to extract strings from the environment in both C and MASM programs. This time I'll talk about the "approved" ways to change the contents of the environment from an application program.

A BRIEF REVIEW First let me recap the crucial information about environment blocks. Recall that the environment for a program is a block of memory containing one or more environment variables, each of which consists of an ASCII string terminated with a zero byte (sometimes called an ASCIIZ string). Each environment variable takes the form:

```
name=parameter
```

For example,

```
PATH=C:\DOS3;C:\TOOLS
```

The environment block is always aligned on a paragraph boundary (that is, its beginning memory address is always evenly divisible by 16), and it may be as large as 32KB. The entire set of ASCIIZ strings is terminated with an additional null byte. The paragraph address of the base of a program's environment is located at offset 002CH in its Program Segment Prefix (PSP).

The original or master environment for the system is owned by the command interpreter (usually COMMAND.COM) that is loaded when the system is turned on or restarted. Strings are placed into the system's master environment block by COMMAND.COM as a result of PATH, SHELL (COMSPEC), PROMPT, and SET commands; default values are always present for the first two. Strings in the environment are used only for informational purposes by COMMAND.COM and by transient programs; they do not affect the operation of the MS-DOS operating system proper.

Each program that runs under MS-DOS has its own environment block, which is supplied by its parent program (again, usually COMMAND.COM). In most cases, the child program's environment is an exact copy of the parent's environment. For special occasions, the parent can instead provide the child with an expanded, altered, or empty environment. Changes a program has made in its own environment are reflected in the environment blocks of programs that it launches. These changes are lost when the program terminates, however, and are never visible to its parent or to any programs that execute after it.

■ An application program might want the "child" COMMAND.COM to display a special prompt to remind the user that it is still active.

A C program can use the pointer array `envp`, supplied as an argument to its main function, to inspect the environment. Alternatively, the program can call the library routine `getenv` to extract a selected string from the environment. MASM programs can use the procedure GETENV, which appeared in the last column, to perform the same function.

CHANGING THE ENVIRONMENT Since the environment for each program is static, and since a program cannot touch the system's master environment block or even the environment of its immediate parent in any "well-behaved" way, why would it ever want to alter its own environment?

The main reason for changing the environment is to affect the behavior of a child program. Consider an application program, such as a word processor, that starts up a secondary copy of COMMAND.COM so the user can enter MS-DOS commands without losing his working context. The word processor might want the "child" COMMAND.COM to display a special prompt that would remind the user that the application is still active. Or again, it might want to limit the programs that could be run from the child command processor by modifying the environment PATH string or removing it altogether.

A C program can use the library function `putenv` to change the parameter or variable portion (the part of the string after

the equals sign) of any environment variable. The same function can also be used to add a new variable to the environment or to delete one. Putenv is called with a pointer to a string of the familiar form

name=parameter

and returns 0 if the function is successful, or -1 if it failed.

As you've probably come to expect when dealing with these seemingly simple C library functions, much more is going on than meets the eye. First, if *name* does not already exist in the environment, or if *name* exists but the new parameter is longer than the old one, there will be a space crunch. The memory block that holds a program's environment sits just below the program itself and is just big enough to hold the environment passed to it from its parent. Therefore, the existing environment cannot be "grown" in place.

Consequently, the putenv function must allocate a new block of memory to hold the modified environment, copy the unchanged strings from the old environment into the new, and then append the new or modified variable passed to it. Then putenv must update all the pointers in the envp array originally passed to the main function of the C program, since it has no way to predict when or if that program will use envp. The pointer at offset 002CH of the program's PSP must be updated to reflect the new environment address. Finally, putenv can release the memory block holding the original environment back to the system's free memory pool, so that it can be reused on future allocation calls.

A complicated process, indeed, for such an apparently simple task! It is now obvious that putenv may fail unexpectedly if the system doesn't have enough free memory. This is not a serious problem, however, since ordinarily you would use putenv only before starting up a child program, and if there isn't enough memory to change the environment, there probably isn't enough to run the child.

Figure 1 contains a simple program, MODENV.C, that demonstrates the use of putenv to change the PROMPT string in the environment, then spawns a secondary command processor. When the child COMMAND.COM runs, it displays a special prompt reminding the operator to use EXIT to return to the parent program. When MODENV terminates, its own modified environment is of course discarded, and the prompt displayed by its own parent COMMAND.COM will return.

```
/*
        MODENV.C,
        (c) 1987 Ziff Communications Co., by Ray Duncan
*/

#include <stdio.h>
#include <process.h>

main(argc,argv,envp)
int argc;
char *argv[];
char *envp[];
{   char comspec[80];           /* COMSPEC= value goes here */
    int status;                 /* scratch storage */

                                /* get location of COMMAND.COM from
                                   environment COMSPEC= variable */
    strcpy( comspec, getenv("COMSPEC") );
    if( comspec[0] == NULL )
        {   puts("\nNo COMSPEC found in environment.");
            exit(1);
        }
                                /* change PROMPT= environment variable */
    if( putenv("PROMPT=Enter EXIT to Return to MODENV$_$p$g") )
        puts("\nCall to PUTENV failed.");

                                /* announce launch of COMMAND.COM */
    puts("\nNow spawning a new copy of COMMAND.COM.");

                                /* now spawn new command processor */
    if( spawnle(P_WAIT,comspec,comspec,NULL,envp) == -1 )
        puts("\nEXEC of COMMAND.COM failed");

                                /* announce return from COMMAND.COM */
    puts("\nBack from new COMMAND.COM, MODENV is exiting.");

    exit(0);                    /* now terminate */
}
```

Figure 1: *MODENV.C, a demonstration of the C* putenv *function.*

PUTENV FOR MASM PROGRAMS

To duplicate the same capability in a MASM program, you have to do everything the hard way. PUTENV.ASM, in Figure 2, is a procedure you can call from a MASM application to add, delete, or change an environment variable. It relies in part on the GETENV.ASM procedure presented in the last column. An important requirement for using the PUTENV subroutine is that your MASM program must release any extra memory with interrupt 21H function 4AH when it first gets control. Otherwise, there will be nothing for PUTENV to allocate.

PUTENV must be called with the address of the new or modified environment variable in registers DS:SI and with the segment of the program's Program Segment Prefix in register ES. The logic of PUTENV is straightforward. First, it saves the PSP address, picks up the base address of the program's current environment block, and scans the existing environment to find its length.

Next, it determines the length of the environment variable passed by the calling program. It then has the worst-case information necessary to allocate a memory block of sufficient size to hold the environment. If the allocation fails, GETENV returns to the calling program with an error code. Otherwise, GETENV copies the old environment block to the new, inserts or appends the changed or added environment variable, and tacks on an extra null byte to mark the end of the environment. Finally, PUTENV updates the pointer at SP:002CH, releases the original environment block with a call to interrupt 21H function 49H, and returns a success code to the calling program.

The demonstration program MODENV.ASM, in Figure 3, illustrates using the PUTENV.ASM subroutine. Assemble MODENV and PUTENV.ASM:

```
MASM MODENV;
MASM PUTENV;
```

```
        name    putenv
        page    55,132
        title   PUTENV modify environment variable
;
; (c) 1987 Biff Communications Co., by Ray Duncan
;
; Call with:    DS:SI = new ASCIIZ environment variable
;               ES    = segment of program segment prefix
;
; Returns:      AX    = 0 if successful, -1 if failed

DGROUP  group   _DATA

_TEXT   segment word public 'CODE'

        assume  cs:_TEXT

        public  putenv          ; make visible to Linker

        extrn   getenv:near

                                ; names for working storage
oldenv  equ     [bp-2]          ; segment of old environment
envlen  equ     [bp-4]          ; length of old environment
newenv  equ     [bp-6]          ; segment of new environment
pspseg  equ     [bp-8]          ; segment of program segment prefix
oldlen  equ     [bp-10]         ; length of existing variable
newlen  equ     [bp-12]         ; length of new env. variable
newname equ     [bp-14]         ; offset of new name portion
newvar  equ     [bp-16]         ; offset of new param. portion

putenv  proc    near            ; modify/add environment variable

        push    bp              ; set up stack frame for
        mov     bp,sp           ;  working storage
        sub     sp,16

        mov     newname,si      ; save offset of new variable
        mov     pspseg,es       ; save PSP segment
        mov     es,es:[002ch]   ; pick up segment of old
        mov     oldenv,es       ;  environment and save it

        push    cx              ; save other registers
        push    si
        push    di

                                ; find old environment length
        mov     cx,8000h        ; assume max = 32 KBytes
        xor     di,di           ; ES:DI = environment base
        xor     al,al
put1:   repne scasb             ; scan for double null (can't use
        scasb                   ; SCASW since might be on odd addr)
        jnz     put1

        mov     envlen,di       ; save length of old environment

        mov     di,si           ; find length of new env. variable
        mov     cx,de           ; ES:DI = addr of new variable
        mov     es,cx
        mov     cx,-1
        xor     al,al

        repne scasb             ; scan for terminating null byte
        not     cx              ; now CX = length including null
        mov     newlen,cx       ; save length of new variable

                                ; attempt to allocate memory
                                ; block for new environment...
        mov     bx,cx           ; length of old environment
        add     bx,envlen       ; + length of new variable
        mov     cl,4            ; divide by 16 and round
        shr     bx,cl           ; up to find paragraphs to
        inc     bx              ; allocate for new environment
        mov     ah,48h          ; Fxn 48h=allocate memory block
        int     21h             ; transfer to MS-DOS
        jnc     put2            ; jump if allocation succeeded

        mov     ax,-1           ; otherwise, return error flag
        jmp     put6

put2:   mov     newenv,ax       ; save new environment segment

        mov     di,offset envar ; copy name portion of new
                                ; variable to local storage

put3:   movsb                   ; copy characters up to '='
        cmp     byte ptr [si],'='
        jne     put3            ; loop until end of name found
        xor     al,al           ; append null byte to name
        stosb

        inc     si              ; save address of param.

        mov     newvar,si       ; portion of new variable

        mov     si,offset envar ; check if new environment
        mov     es,oldenv       ; variable has a previous value
        call    getenv          ; in old environment
        mov     oldlen,ax       ; save length of value, if any

        or      ax,ax           ; was it present in old block?
        jnz     put4            ; yes, PUTENV the hard way

        push    ds              ; no just copy existing environment
                                ; and add the new variable

        mov     ds,oldenv       ; DS:SI = old env. block
        mov     es,newenv       ; ES:DI = new env. block
        mov     cx,envlen       ; CX = length of old environment
        dec     cx              ; less the extra null byte
        xor     si,si
        xor     di,di
        rep movsb               ; copy the old stuff

        pop     ds              ; DS:SI = address of new variable
        mov     si,newname      ; ES:DI = end of new environment
        mov     cx,newlen       ; CX = length of new variable
        rep movsb               ; append the new variable
        xor     al,al           ; and the extra null byte
        stosb                   ; marking end of environment
        jmp     put5            ; go update PSP env. pointer

put4:                           ; come here on the messy case,
                                ; env. variable already exists
                                ; ES:DI = offset+1 of '=' in
                                ; old variable from 'getenv'
        push    ds              ; copy old environment to new
        mov     ax,es           ; up through the '=' of the
        mov     ds,cx           ; variable we are changing
        mov     cs,di           ; DS:SI = old environment
        mov     es,newenv       ; ES:DI = new environment
        xor     si,si           ; CX = offset+1 of '='
        xor     di,di           ;      in old variable
        rep movsb

        pop     ds              ; now let DS:SI = offset+1
        push    si              ; of '=' in new variable
        mov     si,newvar       ; and CX = length of portion
        mov     cx,newname      ; following the '='
        add     cx,newlen
        sub     cx,newvar       ; copy the new parameter portion
        rep movsb               ; to the new environment

        pop     si              ; skip over parameter portion
        add     si,oldlen       ; of the old variable
        inc     si              ; and its null byte

        push    ds              ; now copy remainder of
        mov     ds,oldenv       ; old environment to new one
        mov     cs,envlen       ; total length less portion
        sub     cs,si           ; already copied and length
        rep movsb               ; of old environment variable
        pop     ds

put5:                           ; PUTENV function successful,
        mov     es,oldenv       ; release old environment block
        mov     ah,49h
        int     21h             ; transfer to MS-DOS

        mov     es,pspseg       ; update pointer to new
        mov     ex,newenv       ; environment in caller's PSP
        mov     es:[002ch],ax

        xor     ax,ax           ; return success code

put6:   pop     di              ; restore registers
        pop     si
        pop     cx
        mov     sp,bp           ; [illegible] stack frame
        pop     bp
        ret                     ; back to caller

putenv  endp

_TEXT   ends

_DATA   segment word public 'DATA'

envar   db      80 dup (0)      ; name of new environment var.
                                ; for call to 'getenv'
_DATA   ends

        end
```

Figure 2: *PUTENV.ASM, a routine for adding or modifying environment variables.*

To create the executable program MODENV.EXE, you need the object modules MODENV.OBJ and PUTENV.OBJ that result from these two assemblies. You also need the GETENV.OBJ module you assembled in the last column. Once these object modules are ready, enter the command

```
LINK MODENV+PUTENV+GETENV,MODENV;
```

When you run MODENV, it will display the current contents of the environment block, change the PROMPT string, display the contents of the modified environment block, and then terminate. Once

```
            name        modenv
            page        55,132
            title       MODENV --- demo of PUTENV function
;
; (c) 1987 Ziff Communications Co., by Ray Duncan
;

stdin       equ         0               ; MS-DOS handles for
stdout      equ         1               ; standard devices
stderr      equ         2

cr          equ         0dh             ; ASCII carriage return
lf          equ         0ah             ; ASCII line feed

stksize     equ         128             ; size of stack segment

            extrn       putenv:near     ; changes environment string

DGROUP      group       _DATA,STACK

_TEXT       segment word public 'CODE'

            assume      cs:_TEXT,ds:DGROUP,es:STACS

main        proc        far             ; entry point from MS-DOS

            mov         ax,DGROUP       ; make our data segment
            mov         ds,ax           ; addressable

                                        ; now give back extra memory...
            mov         es,ax           ; let AX = segment of PSP base
            mov         bx,es           ; and BX = segment of stack base
            sub         bx,ax           ; reserve seg stack - seg psp
            add         bx,stksize/16   ; plus paragraphs of stack
            inc         bx              ; round up for safety
            mov         ah,4ah          ; fxn 4ah = modify memory block
            int         21h             ; transfer to MS-DOS
            jc          main0           ; exit if resize failed

            mov         pspseg,es       ; save segment of PSP

            mov         dx,offset msg1  ; display message
            mov         cx,msg1_len     ; 'Before call to PUTENV'
            call        pmsg

            mov         es,es:[002ch]   ; get environment pointer
            call        dumpenv         ; dump environment strings

                                        ; change PROMPT= in environment
            mov         es,pspseg       ; ES = PSP segment
            mov         si,offset prompt; DS:SI = new value for PROMPT
            call        putenv

            mov         dx,offset msg2  ; display message
            mov         cx,msg2_len     ; 'After call to PUTENV'
            call        pmsg

            mov         es,pspseg       ; let ES = segment of environment
            mov         es,es:[002ch]
            call        dumpenv         ; dump environment strings

main0:      mov         ax,4c00h        ; final exit to MS-DOS
            int         21h

main        endp


dumpenv proc    near                    ; dump contents of environment
                                        ;  block to standard output
                                        ; call with ES = env. base

            xor         di,di           ; initialize env. offset

dump1:                                  ; reached end of env. block?
            cmp         byte ptr es:[di],0
            je          dump2           ; yes, exit

            mov         dx,offset msg3  ; no, move to new line
            mov         cx,msg3_len     ;  by sending carriage
            call        pmsg            ;  return/line feed

            mov         dx,di           ; save address of next
            mov         cx,-1           ;  environment variable
            xor         al,al           ;  and find its length
            repne scasb                 ; scan for terminating null
            not         cx
            dec         cx              ; now CX = length
            push        ds              ; save our data segment
            mov         ax,es           ; let DS:DX = address
            mov         ds,ax           ;  of environment variable
            call        pmsg            ;  and display it
            pop         ds              ; restore our data segment
            jmp         dump1           ; get next env. variable

dump2:      ret                         ; back to caller

dumpenv endp


pmsg        proc        near            ; print message on stdout
                                        ; DS:DX=message, CX=length
            mov         bx,stdout
            mov         ah,40h
            int         21h
            ret

pmsg        endp

_TEXT       ends


_DATA       segment word public 'DATA'

pspseg      dw          ?               ; segment of program segment prefix

msg1        db          cr,lf,'Before call to PUTENV:'
msg1_len    equ $-msg1

msg2        db          cr,lf,lf,'After call to PUTENV:'
msg2_len    equ $-msg2

msg3        db          cr,lf           ; carriage return/line feed
msg3_len    equ $-msg3

prompt      db          'PROMPT=This is a test:$_$p$g',$

_DATA       ends


STACK       segment para stack 'STACS'

            db          stksize dup (?)

STACK       ends

            end         main
```

Figure 3: *MODENV.ASM demonstrates the use of the PUTENV routine.*

back at the COMMAND.COM prompt, you can verify that the changes made by MODENV were confined to its own environment by entering the SET command, to display the variables in the system's master environment block.

MASM, VERSION 5.0 Microsoft has now released Version 5.0 of its Macro Assembler package. This package incorporates so many improvements that it warrants a quick look here, although this summary should not be construed as a formal *PC Magazine* review.

The new MASM has a few incremental enhancements: it handles larger symbol tables; it's about 25 percent faster than Version 4 (by my own timings, which also show it to be three times as fast as MASM, Version 3); and it adds support for the new 80386 and 80387 instructions. It also has new directives (.MODEL, .CODE, .DATA, and .STACK) that make it easy to create a properly segmented program that abides by the same conventions used by the Microsoft language compilers.

■ The new MASM is 25 percent faster than Version 4 and three times as fast as Version 3.

But the best reasons to update to MASM 5.0 are the goodies that come with it: the new documentation and *CodeView*.

The MASM manual has been completely rewritten and now comes in three convenient softcover volumes: a reference manual that covers the various assembler directives and mnemonics; a utilities manual for the linker, debugger, EXEMOD, et al.; and a programming manual that lays out in detail how to integrate MASM subroutines into BASIC, FORTRAN, and C programs.

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■ POWER PROGRAMMING

There is also a nifty, wire-bound MASM quick reference that is beautifully designed and executed. It includes the command-line formats and switches for MASM and all associated tools, the MASM directives, and all of the Intel 80*x*86 family instruction opcodes, timings, and addressing modes up through the

■ The MASM reference indicates a keen understanding of the needs of a working programmer.

80386 and 80387. It is easily the best quick reference for these processors I have ever come across, and it indicates that someone in the Microsoft documentation department has an unusually keen understanding of the needs of a working programmer.

Version 2.0 of *CodeView*, which is bundled with the MASM 5.0 package, is a souped-up revision of Microsoft's widely acclaimed, window-oriented symbolic debugger for Microsoft C. The new *CodeView* can also be used with MASM, FORTRAN, and BASIC programs. You can single-step through your MASM source code, set "watchpoints" to monitor the value of variables as the program executes, and set "tracepoints" that will interrupt program execution when an expression takes on a certain value. The display of register contents, CPU flags, machine code, and the debugged program's screen display can be quickly toggled on and off with function keys.

The new *CodeView* really comes into its own when you debug a program that is linked from modules written in different languages, such as C and MASM. As you enter each subroutine or function, *CodeView* automatically finds the associated source file and displays it in the appropriate format, with or without the associated machine code, as you select. The convenience and power of this debugging tool for mixed-language programming is truly hard to appreciate until you've tried it for yourself. PC

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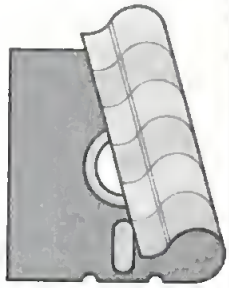
SPREADSHEET CLINIC



Trapping user input when using pausing macros; changing date labels into serial date values; simplifying column inversion; entering Point mode while editing a formula.

POINT MODE REVISITED

In "Getting to Point Mode" (Spreadsheet Clinic, *PC Magazine*, June 23, 1987), John Predmore suggests that you must press either the Up or Down Arrow key to enter the Point mode while editing a formula. After you press either of these keys, you can then use the Left and Right Arrow keys to move the cell pointer to the left and right, but if you press them before hitting Up or Down, you'll simply move the cell pointer within the formula.

I've discovered an alternative way to enter the Point mode while editing a formula. Once you have pressed the Edit key and positioned the cursor to the right of a mathematical operator or opening parenthesis at the end of the formula, press the Edit key again. When you do this, *1-2-3* will switch from the Edit mode to the Value mode. While *1-2-3* is in this mode, pressing any arrow key—even Left or Right—takes it into the Point mode.

Carlos Garibotti
Buenos Aires, Argentina

This is a useful time-saver, since using the Edit key instead of the Up or Down keys to enter the Point mode makes it easier to point to cells to the left or right of the one that contains the formula you are editing.

MORE ON INVERTING COLUMNS

Eric Marcus ("Inverting Columns of Data," Spreadsheet Clinic, *PC Magazine*, August 1987) suggests the use of @Index functions to invert the information in a column of a *1-2-3* spreadsheet. Although his method works, it is quite complex.

To invert columns of information in my *1-2-3* spreadsheets, I use the following sequence instead. First, I use the /Worksheet Insert Column command to insert a new column to the right of the one I want to invert. Next, I use the /Data Fill command to fill that column with a series of ascending values—one for each of the entries I want to invert. Third, I use the /Data Sort Data-Range command to define the cells that contain the entries I want to invert and the cells that contain the ascending values as the Data range. Then I use the /Data Sort Primary-Key command to define a cell in the column of ascending values as the primary sort key, and I select Descending order. At that point, I choose Go to sort the entries. Since the values in the primary-key column are in ascending order, this sort reverses the order of the entries in both columns. Finally, I use the /Worksheet Delete Column command to delete the column that I inserted at the beginning of the process.

To avoid issuing this sequence of commands each time I want to invert a column of information, I've coded them into the macro shown in Figure 1. Use this macro to invert the data in any column.

Edward Engleman
Malvern, Pennsylvania

Mr. Engleman's clever macro contains a couple of tricks that are worth pointing out. First, it uses the formula @ROWS (RANGE)−1 as the argument of the {down} command that highlights the Fill range. Second, to identify the Data range for the sort, the macro issues the /Data Fill Data-Range command twice. The first time, it specifies the range named RANGE (the one that contains the entries you want to invert) as the Data range; the second time, it presses the {right} key to expand that range one column to the right to include the ascending series of values.

MANAGING FILES

After running the macro in "Managing Files" (Spreadsheet Clinic, *PC Magazine*, September 15, 1987), I still need to convert the entries in the date column into serial date values. Assuming that the date labels occupy cells D16..D35, I do this as

```
        A        B        C        D        E        F
1   \i        /rncRANGE~{?}~
2             {Goto}RANGE~{Right}
3             /wic~
4             /df{BS}.{Down @ROWS(RANGE)-1}~1~1~8192~
5             /dsrdRANGE~d{Right}~p~d~g
6             /wdc~
7
```

Figure 1: *This macro inverts columns of data.*

■ SPREADSHEET CLINIC

■ The formulas that extract the year, month, and day components return correct results every time.

follows: First, I enter the function @FIND("-",D16,0) into cell F16 and copy it into cells D17..D35. These functions return the position of the first hyphen (-) character in each date label. Second, I enter the function @FIND("-",D16,3) into cell G16 and copy it into cells G17..G35. These functions return the position of the second hyphen in each date label. Third, I enter the function @REPLACE(D16,F16,1,"/") into cell H16 and copy it into cells H17..H35. These formulas replace the first hyphen in each date label with a slash (/). Fourth, I enter the function @REPLACE(H16,G16,1,"/") into cell I16 and copy it into cells I17..I35. These functions replace the second hyphen in the results of the functions in cells H16..H35 with a /. Finally, I enter the function @DATEVALUE(I16) into cell J16 and copy it into cells J17..J35. These functions return the serial date values of the date labels.

Lee Bonnor
Chicago, Illinois

This method works quite nicely, but it uses up a lot of space in the worksheet. Instead of using a separate cell for each step of the conversion process, you can consolidate the steps into a single formula. For example, to convert the date labels in cells D16..D35 into serial date values, you could enter the function

```
@DATEVALUE(@REPLACE(@REPLACE(D16,@FIND
("-",D16,0),1,"/"),@FIND("-",D16,3),1,"/"))
```

[Note: The two lines shown above must be entered as a single line.—Ed.] *into cell F16 and copy it down into cells F17..F35.*

CONVERTING DATE LABELS

I sometimes bring information from database files into *1-2-3* for manipulation. The date field in those files contains entries in six-digit, yymmdd form. For example, the date for January 15, 1989 is stored as 890115. When I import such dates, *1-2-3* converts them into labels: the date entry 890115 becomes the label '890115.

After I import the date labels, they must be converted into serial date values. To accomplish this, I first use the Edit, Home, and Del keys in combination to strip the label prefix from the beginning of each entry. Then I use a series of formulas to extract the year, month, and day components of the date.

For example, assume that cell A3 contains the value 890115. To extract the year component, you enter the function @INT(A3/10000) into cell B3. This function returns the value 89—the year component of the date. To extract the month component, you simply enter the formula @INT(A3/100)−B3*100 into cell C3. This formula returns the value 1—the month component of the date. To extract the day component, you enter the formula +A3−((C3*100)+(B3*1000)) into cell D3, which returns the value 15—the day component of the date.

After you use these formulas to extract the components of the date into different cells, another formula converts them into a serial date. In the present example, to calculate the serial date value whose year, month, and day components are in cells B3, C3, and D3, respectively, you should enter the formula

```
(365.25*B3)+(30.44*C3)+D3-30.1
```

in cell E3. This formula returns the value 32522, which is the serial date value for January 14, 1989.

As is clear from Figure 2, the formulas that extract the year, month, and day components return the correct results every time. Because of approximations inherent in the serial date formula, there may be an occasional error of one day.

Robert H. Dimond
Silver Spring, Maryland

Up to the last step, the method Mr. Dimond describes is precisely the one we'd use to convert dates in mmddyy form into serial date values in 1-2-3, Release 1A. In place of his final formula (to calculate the serial date value), however, we would use a simple @DATE function. For example, to calculate the serial date value from the year, month, and day components in cells B3, C3, and D3, respectively, we would use the function @DATE(B3,C3,D3).

	A	B	C	D	E
1					SERIAL
2	VALUE	YEAR	MONTH	DAY	DATE VALUE
3	890115	89	1	15	14-Jan-89
4	890215	89	2	15	14-Feb-89
5	890315	89	3	15	16-Mar-89
6	890415	89	4	15	15-Apr-89
7	890515	89	5	15	16-May-89
8	890615	89	6	15	15-Jun-89
9	890715	89	7	15	16-Jul-89
10	890815	89	8	15	15-Aug-89
11	890915	89	9	15	15-Sep-89
12	891015	89	10	15	15-Oct-89
13	891115	89	11	15	14-Nov-89
14	891215	89	12	15	15-Dec-89
15	900115	90	1	15	14-Jan-90
16	900215	90	2	15	14-Feb-90
17	900315	90	3	15	16-Mar-90
18	900415	90	4	15	16-Apr-90
19	900515	90	5	15	16-May-90
20	900615	90	6	15	16-Jun-90

Figure 2: *The formulas in columns B, C, D, and E of this worksheet convert the date labels in column A into serial date values.*

This function always returns the correct date value.

People who use 1-2-3, *Release 2, can use string functions to convert date labels in mmddyy form into a serial date value. For example, to convert a label in cell A3, you could use the function*

```
@DATE(@VALUE(@LEFT(A3,2)),@VALUE
(@MID(A3,2,2)),@VALUE(@RIGHT(A3,2)))
```

[Note: The two lines above must be entered as a single line.—Ed.]

USING THE {?} COMMAND

In many of my macros, I've used the {?} key to pause a macro while the user reads a message, rather than to solicit input. After reading the message, the user is supposed to press Enter to continue the macro's execution. To create these pauses, I used to use statements like

```
{Goto}MESSAGE~{?}/xgRESUME~
```

Unfortunately, if the user happened to type something during the pause, the macro would blow up. For example, if the user typed test, *1-2-3* would enter the label test/xgRESUME into the cell named MESSAGE instead of branching the macro to the cell named RESUME.

■ If the user happened to type something during the pause, the macro would blow up.

I now avoid this problem by following the {?} command with an {Esc} command. This instructs *1-2-3* to press the Esc key as soon as the user presses Enter. This key clears anything from the Edit line that the user typed during the pause, and the macro will continue executing normally.

Ralph D. Sappe
Poughkeepsie, New York

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Douglas Cobb is the author of 1-2-3: Tips, Tricks, and Techniques. *Steven Cobb writes the* 1-2-3 User's Journal *and the* Symphony User's Journal.

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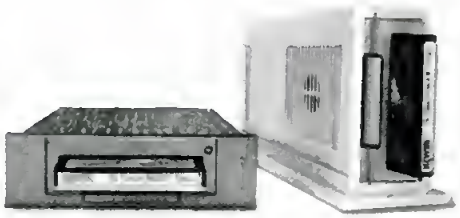

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CIRCLE 204 ON READER SERVICE CARD

■ PAUL SOMERSON

USER-TO-USER

Unattended printing techniques, safer ways to move files between subdirectories, mastering dual-printer systems, and far speedier IF ERRORLEVEL batch processing.

AUTOMATED PRINTING

It's difficult to run the DOS PRINT command in a batch file without user intervention, since PRINT normally forces the user to hit the Enter key (or enter another device name) when confronted with the "Name of list device [PRN]:" prompt.

It's fairly simple to patch PRINT.COM so that it automatically accepts the PRN default without stopping to ask the user for confirmation. Here's how:

Put a copy of PRINT.COM and DEBUG.COM on your disk and type DEBUG PRINT.COM. Then at the DEBUG "-" prompt, type RCX and hit the Enter key to find out how long the PRINT.COM file is. DEBUG will print an answer that looks something like

```
CX 2342
:
```

At this point hit the Enter key again to get back to the DEBUG hyphen prompt. The four-digit number following CX is the hex representation of the file length. Type in the following command, substituting the four-digit number you get in place of the 2342 if yours is different (2342 is for DOS 3.3).

```
S 100 L2342 B4 0A
```

DEBUG should respond with something like

```
452A:1946
```

(Again, this is for Version 3.3; other versions will differ slightly.) In any case, ignore the four hex digits to the left of the colon, and the colon itself. We're interested in just the four-digit hex number to the right of the colon.

Add 2 to this hex number. In this case it's easy: 1946 + 2 = 1948. But be careful, since these are hex numbers. 1949 + 2 = 194B, *not* 1951!

Then make sure you're in the right place by typing

```
D 1948 L2
```

(substituting the four-digit hex number to the right of the colon, above, if yours is different). You should see something like

```
452A:1940
```

at the left edge of the screen,

```
CD 21
```

in the middle, and

```
.!
```

at the right edge. If you see that the hex numbers in the middle of the screen are *not* CD 21, type Q to quit and start over again. If you do see CD 21, then type

```
E 1948 90 90
```

and then hit Enter, type W and hit Enter, and then type Q and hit Enter. Once again, substitute the number that you got when you added 2 to the hex address above, in place of the 1948, if yours is different.

Joseph DiGrazio
Gaithersburg, Maryland

While this does work, if you don't like the idea of patching your DOS files, you can always use the line

```
ECHO PC | MORE | PRINT
```

in your batch files instead of just PRINT. If your batch file uses just this line, or ends with it, hit the Enter key at the end of this line when you create the file.

MOVING EXPERIENCE

Normally, when users move a file from one subdirectory to another, they first copy the file with the COPY command and then use ERASE to delete the original. Or they write a short batch file to do it:

```
COPY %1 %2
ERASE %1
```

The problem with such a batch file is that if an incorrect destination is specified, it can fail to make the copy but then go ahead and erase the original anyway. A better way is to use the MOVEIT.BAT batch file in Figure 1.

MOVEIT.BAT starts by checking to see if you entered the correct number of parameters, and gives you a help message if you didn't. It then copies the file, using %2\%1 so you don't have to spell out the name of the file in both locations (wildcards will work). However, this limits you a bit, since you have to be in the directory of the file you are trying to copy. (You could modify it to COPY %1 %2 if you like, which would let you copy files without first having to log into the files' subdi-

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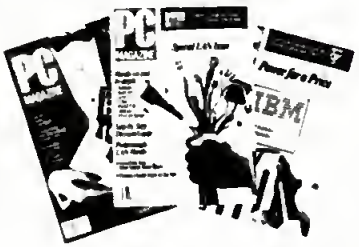

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■ USER-TO-USER

```
ECHO OFF
IF NOT %2! == ! GOTO TEST
ECHO You must specify what to move
ECHO and where to move it tn, eg:
ECHO %0 CHKDSK.COM \DOS
GOTO QUIT
:TEST
IF NOT EXIST %2\%1 GOTO COPY
ECHO %1 is already in %2
ECHO ^GTo prevent overwriting %1, hit
ECHO Ctrl-Break right now.  Otherwise
PAOHE
:COPY
COPY %1 %2\%1>NUL
IF NOT EXIST %2\%1 GOTO ERROR
ERASE %1
GOTO QUIT
:ERROR
ECHO Errnr in destinatinn specified, nr
ECHO the file to be moved is not in
CD
:QUIT
```

Figure 1: *MOVEIT.BAT batch file for moving files from one subdirectory to another.*

rectory—but you would have to spell out the name of the file in both places.)

Finally, it erases the original file only if it finds the new one. Two quick notes—the ^G will beep the speaker. You can create it in DOS by holding down the Ctrl key and hitting G, or in a program like *WordStar* by typing ^P^G. And the >NUL will prevent the "One file(s) copied" message from cluttering up your screen.

Milt Hull
Sacramento, California

It's smart to confirm that the copy was indeed made before deleting the original. But versions of DOS earlier than 3.0 will have problems with IF EXIST tests and PATHs. Another good reason to upgrade.

We added a few touches, like the %0 to ECHO the real name of the batch file if you decide to rename it, and a CD to print the current path. And we installed a test that checks to make sure the file isn't already at the destination subdirectory before you copy it. This prevents you from accidentally overwriting files. If you see a message warning you that you're about to obliterate an existing file, just hit Ctrl-Break and then the Y key to abandon the process. Otherwise, hit any key to proceed.

PRINTER SNIFFER

I recently obtained a second printer and hooked it up to my LPT2 port. But while I could switch printers by switching printer ports, I couldn't tell which printer was online until the printout began.

To solve the problem, I wrote a short program called WHICHLPT.COM, which checks to see which printer port—LPT1 or LPT2—is active and returns a DOS ERRORLEVEL of 1 or 2, respectively. To create the program, use a pure ASCII word processor to create the WHICHLPT.SCR file shown in Figure 2. Leave a blank line above the RCX, and make sure you hit the Enter key at the end

```
N WHICHLPT.COM
A       100
MOV     AX,0040
MOV     DS,AX
MOV     BX,0008
MOV     AL,[BX]
CMP     AL,BC
JZ      0112
MOV     AL,02
JMP     0114
MOV     AL,01
MOV     AH,4C
INT     21

RCX
18
W
Q
```

Figure 2: *DEBUG script file to create WHICHLPT.COM, a program that checks which printer port is active.*

of each line, especially the last one (with the Q).

Then put WHICHLPT.SCR and DEBUG.COM on your disk and type

```
DEBUG < WHICHLPT.SCR
```

The TESTLPT.BAT batch file in Figure 3 tests which printer is active.

The WHICHLPT.COM file checks the value it finds at address 0040:0008H. If it's 188 (decimal), LPT1 is active; otherwise the program assumes LPT2 is active. It then puts a 1 onto the AL register for LPT1 and a 2 for LPT2, and terminates using 4CH.

Kevin H. Jones
Randallstown, Maryland

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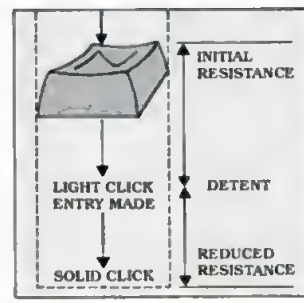

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```
ECHO OFF
CLS
WHICHLPT
IF ERRORLEVEL 2 GOTO TWO
IF ERRORLEVEL 1 GOTO ONE
GOTO END
:ONE
ECHO PORT 1 IS ACTIVE
GOTO END
:TWO
ECHO PORT 2 IS ACTIVE
:END
```

Figure 3: *TESTLPT.BAT batch file works with WHICHLPT.COM to test which printer is active.*

Now that everyone is buying second laser and color printers, this can come in very handy.

By the way, if you don't have a printer port swapper, you might want to try one of our old favorites, Charlie Petzold's tiny PRNSWAP gem. First of all, type in the PRNSWAP.SCR script shown here in Figure 4.

```
N PRNSWAP.COM
A    100
POP  DS
MOV  AX,[408]
XCHG AX,[40A]
MOV  [408],AX
INT  20

R CX
D
W
Q
```

Figure 4: *DEBUG script to create Charlie Petzold's PRNSWAP.COM to switch between LPT1 and LPT2.*

Then type DEBUG < PRNSWAP.SCR to create the file PRNSWAP.COM. Running it successively toggles between LPT1 and LPT2. As Charlie warns, this may not work if software print buffers have been loaded earlier.

FASTER ERRORLEVEL TESTS

The DOS ERRORLEVEL feature can give your batch files real branching abilities. But you normally have to check the value with a long series of IF statements, which can become cumbersome if there are too many different possible ERRORLEVEL values.

As LEVEL.BAT in Figure 5 illustrates, using the FOR . . . IN . . . DO statement with an IF and GOTO can simplify the process. It assumes ERRTEST is a program that sets an ERRORLEVEL of 0 if everything went as planned, or else 1 through 5 if it encounters any of five possible errors.

While the sample LEVEL.BAT batch

50 DESKTOP ORGANIZERS.

```
ECHO OFF
ERRTEST
FOR %%E IN (1 2 3 4 5 6) DO IF ERRORLEVEL %%E GOTO LABEL%%E
ECHO Everything is okay
GOTO END
:LABEL1
ECHO ERROR #1
GOTO END
:LABEL2
ECHO ERROR #2
GOTO END
:LABEL3
ECHO ERROR #3
GOTO END
:LABEL4
ECHO ERROR #4
GOTO END
:LABEL5
ECHO ERROR #5
GOTO END
:LABEL6
ECHO ERRORLEVEL GREATER THAN 5
:END
```

Figure 5: *LEVEL.BAT batch file that assumes ERRTEST is a program that sets an ERRORLEVEL of 0 for no errors, or else 1 through 5 if it finds any of five possible errors.*

file example simply prints a message and exits, you could easily modify it to include specific actions to be taken for each error type. (Note that the list of values within the parentheses must be given in ascending order because transfer is to the label associated with the last true condition evaluated. Also, if ERRORLEVEL is some value larger than any in the list, control will transfer based on the last value in the list.)

Incidentally, FOR . . . IN . . . DO commands make it easy to perform multiple tests on one line.

If a batch file could branch only when the user typed in A, B, or C (or the lowercase versions of these), you could test for all six values with:

```
FOR %%V in (A B C a b c)
DO IF X%1 == X%%V GOTO LABEL
```

Of course, this would all have to be on one single line in your batch file, with a

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■ USER-TO-USER

```
E 100 B8 00 4C CD 21
RCX
5
N ERRTEST0.COM
W
E 101 1
N ERRTEST1.COM
W
E 101 2
N ERRTEST2.COM
W
E 101 3
N ERRTEST3.COM
W
E 101 4
N ERRTEST4.COM
W
E 101 5
N ERRTEST5.COM
W
E 101 6
N ERRTEST6.COM
W
Q
```

Figure 6: *DEBUG script file ERRTEST.SCR, which creates seven files for use in testing LEVEL.BAT.*

space between the final parentheses and the D of DO.

James R. Kern
Vancouver, Washington

To test this out, type in the DEBUG script shown in Figure 6 using a pure ASCII word processor or the DOS COPY CON command. Call it ERRTEST.SCR. Then put it and DEBUG (Version 2.0 or later) on your disk and type DEBUG < ERRTEST.SCR to create seven files—ERRTEST0.COM through ERRTEST6.COM. Substitute them one at a time for the ERRTEST line in Mr. Kern's LEVEL.BAT batch file. Each will set an ERRORLEVEL equivalent to the number in its name.

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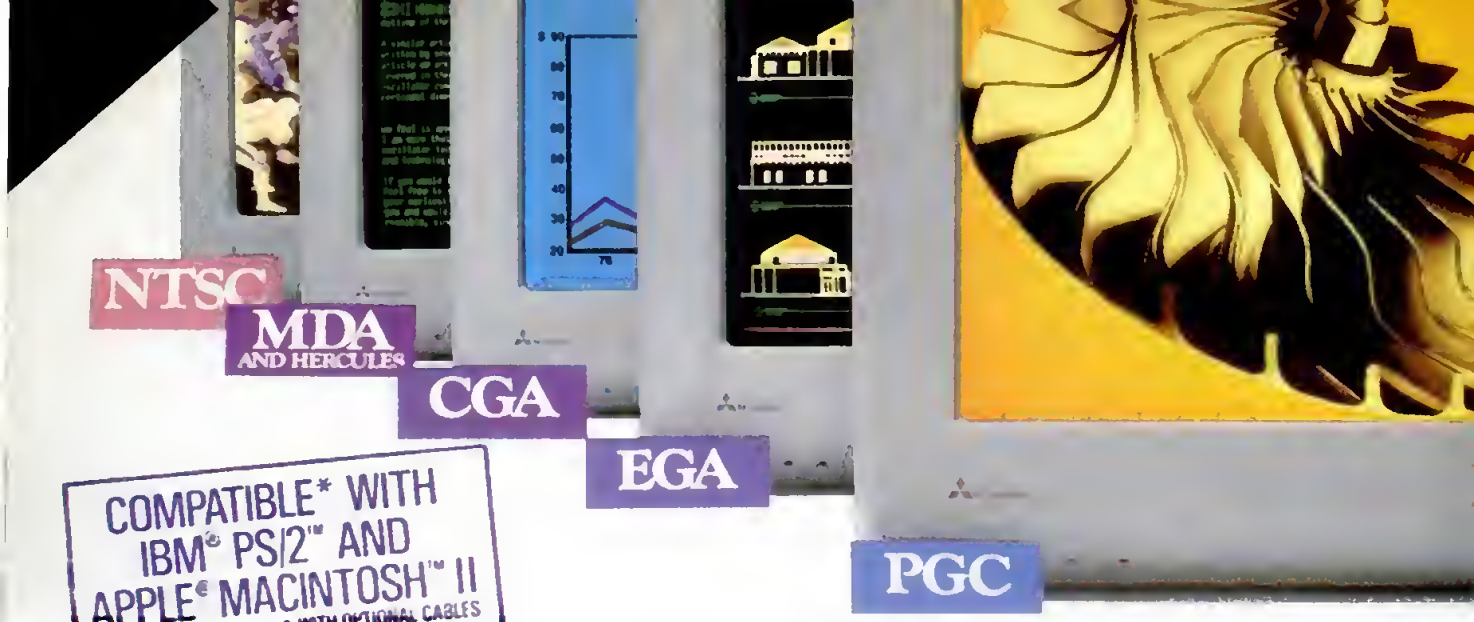

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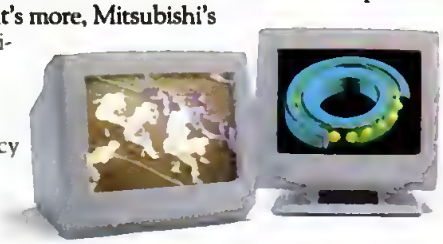

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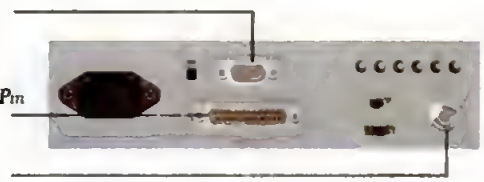

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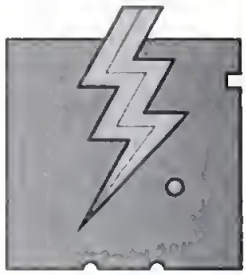
■ EDITED BY CRAIG L. STARK



POWER USER

Adding text markers to WordPerfect documents; taking advantage of FoxBASE timing functions; making Microsoft Word act like WordStar with macros.

SECS() APPEAL

The two programs SECS.PRG and ELAPSEC.PRG, shown in Figure 1, use the new User-Defined Function (UDF) capability of *FoxBASE* 2.0 to track elapsed time between events. Like *Clipper*'s SECONDS() function, SECS() returns the number of seconds elapsed since midnight. You call SECS() with a parameter inside the parentheses—the current TIME(0)—which is accurate to 1/100 of a second:

```
msecs=SECS(TIME(0))
```

ELAPSEC.PRG returns the difference between two SECS(). If the computer's clock runs past midnight between events, an adjustment of 86,399 seconds is made. To determine how many seconds have elapsed since msecs and now, enter

```
? ELAPSEC(msecs,SECS(TIME(0)))
```

These functions were designed to be run from inside a program, so it is assumed that TALK is OFF. To test them from the keyboard, enter SET TALK OFF first. Alternatively, you could add SET CONS OFF after each PARA statement and add SET CONS ON before each RETURN.

Carl Goeb
Memphis, Tennessee

SECS() and ELAPSEC() both produce numeric results accurate to 0.01 seconds. To convert back to the normal representation of TIME(0) as a character string (hr/min/sec/100ths), I added the two parallel functions shown in Figure 2. SECTOC.PRG converts SECS() back to TIME(0) (character string) format and ELAPTIME.PRG compares the two TIME(0) strings.

All four routines can be condensed into a single RETURN line, but in testing I found the code printed here actually runs faster.

FoxBASE *2.0's UDF is limited in many ways compared to its implementation in* Clipper. *For example, you can display SECS(TIME(0)) with a DISP or ? statement, but (a 1,0 SAY SECS(TIME(0)) returns an error. You can REPLACE but not INDEX with* FoxBASE *UDFs.*

FoxBASE *2.0 does allow VALID UDF() in GET statements, but again the implementation is limited. You can't modify the current GET variable, which is frustrating; if you are using the VALID UDF() to look up a record in another database,*

```
*** SECS.PRG   SECS since 12AM
PARA x   && TIME(0) string
PRIV x,y
y=SUBS(x,AT(":",x)+1)
RETURN VAL(x)*3600 + VAL(y)*60 + VAL(SUBS(y,AT(":",y)+1))

*** ELAPSEC.PRG
PARA x,y   && start/end SECS()
PRIV x,y,hr,min
x=IIF(y<x,y+86399-x,y-x)
hr=INT(x/3600)
min=INT(x/60)-hr*60
RETURN STR(hr,2)+":" + STR(min,2)+":" + STR(x-INT(x/60)*60,5,2)
```

Figure 1: FoxBASE *2.0 UDF functions to track elapsed seconds.*

```
*** SECTOC.PRG
* Converts SECS to TIME(0) fmt
PARA x     && SECS() (numeric)
PRIV x,hr,min
hr=INT(x/3600)
min=INT(x/60)-hr*60
RETURN STR(hr,2)+":"+STR(min,2)+":"+STR(x-INT(x/60)*60,5,2)

*** ELAPTIME.PRG
PARA x,y   && start/end TIME(0)
PRIV x,y,z
z=IIF(y<x,SECS(y)+86399-SECS(x),SECS(y)-SECS(x))
z=SECTOC(z)
RETURN z
```

Figure 2: *Parallel time functions that return strings.*

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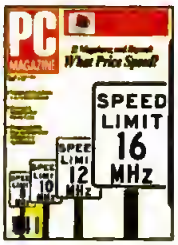

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■ POWER USER

you can't issue any other READ statements inside the UDF.

It's not surprising that FoxBASE's *UDF implementation is not complete—it was added late in development of Version 2.0, so look for substantial enhancements down the line.*

Despite these limits, FoxBASE *users will be delighted with Version 2.0. Memory management is now dynamic, and the bottom line is that you can now run full-scale applications with about 425K free—at least a 100K improvement over Version 1.21. Light-bar menuing has been added, complete with a changing message line. You can SAVE SCREEN TO memvar and RESTORE it later. The list of enhancements goes on and on. Yes, and* FoxBASE *2.0 zooms.*—Brad Stark

MICROSOFT WORD AS WORDSTAR

Programs like *Microsoft Word* boast full use of function keys and cursor control keys as a desirable feature, but *WordStar* users often stay with *WordStar* precisely because it lets them ignore these keys. For these users, *Microsoft Word* may be tempting, but it's ultimately disappointing to use. Even if you use *ProKey* or *SuperKey* to define single-character commands to match their *WordStar* equivalents, you still give up *WordStar*'s two-character Ctrl (^) commands.

With *Word* 4.0, much of this problem disappears. *Word*'s new macro capability lets you define two-character macros such as ^QF, for Quick Find. Many of the macro definitions are straightforward. For example, left one character (^S in *WordStar*) is simply the Left Arrow key (<Left>).

Other macros are more involved because *Word*'s commands don't always act the way a *WordStar* user would expect, and because *Word* sometimes offers two similar but slightly different commands where *WordStar* offers one. Simply redefining ^F as F8 for word right, for example, may create confusion. In *WordStar*, ^F always takes you to the first character of the next word. In *Word*, hitting F8 once highlights the current word, and hitting it a second time highlights the next word. To make *Word* act more like *WordStar*, a better choice is to define ^F as ^<right>.

Figure 3 gives a partial list of two-character macros for incorporating *WordStar* commands into *Word*, along with a list of one-character macros that need more than a simple one-key substitution.

Robert Matthews
Princeton, New Jersey

Be aware that many of these redefinitions will still *not make* Word *behave precisely like* WordStar. *Mr. Matthews's ^T, for example, will have problems deleting a word at the end of a paragraph if you didn't type any spaces between the period and the*

Word Macro (includes WordStar command)	Macro Definition
DELETE Keys	**DELETE Keys**
DelLine^<ctrl Y>	<shift f9><del>
DelWord^<ctrl T>	<f6><esc>s<space><tab>d<enter><left><del>
DelLnRgt^<ctrl Q>y	<f6><end><del>
MOVEMENT Keys	**MOVEMENT Keys**
WordRight^<ctrl F>	^<right>
WordLeft^<ctrl A>	^<left>
ScrollDown^<ctrl Z>	<scrolllock><down><scrolllock>
ScrollUp^<ctrl W>	<scrolllock><up><scrolllock>
SAVING	
SaveReturn^<ctrl K>s	<esc>ts
SaveeXit^<ctrl K>x	<esc>q
OTHERS	**OTHERS**
InsertLine^<ctrl N>	<enter><left>
LastFind^<ctrl L>	<esc>s<enter> or <shift><f4>
QuickAlter^<ctrl Q>a	<esc>r
QuickFind^<ctrl Q>f	<esc>s

Figure 3: *A set of macros for making* Word *4.0 act like* WordStar.

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■ POWER USER

```
<Ctrl-F10>                  Begin macro definition
<Alt-S>                     Call it Alt-S
#$%MARKER%$#                (Just type the exact text)
<F7>Y                       Exit, Yes save the document
<Ctrl-PgUp><CR><CR><CR>     User input for document name
YY                          Yes replace it, Yes really exit
<Ctrl-F10>
```

Figure 4: *An automated way to insert and save text markers in* WordPerfect.

```
<Ctrl-F10>          Begin macro definition
STARTUP             Call it "STARTUP"
<Alt-F2>N           Search and replace, no confirm
#$%MARKER%$#<F2>    Search for the marker
<F2>                Replace with nothing
<Ctrl-F10>          End macro definition
```

Figure 5: A WordPerfect *macro to find text markers on start-up.*

paragraph marker. Still, this is a useful trick for WordStar *users who are moving to* Word*—particularly those who continue to use* WordStar *for specific purposes.*

Also, as a WordStar *user, I would add the command <F10><right> or ^ <right> for* WordStar*'s ^B. The ^B (Bind text) is meant for reformatting paragraphs in* WordStar*, but it's also useful for moving through a document paragraph by paragraph.*—M. David Stone

FINDING YOURSELF

The "Where Was I?" macro in your August 1987 issue repositions the cursor where you left off, all right, but it is unnecessarily complicated.

When faced with the problem of marking where I leave off, I also insert an uncommon symbol (@, #, ^, |, <, >, etc.) as a marker. After retrieving the marked file, I simply use *WordPerfect*'s Search function (F2) to find the marker. It's faster and less complicated, and it saves a macro key for other uses.

Or I can use multiple letters instead of symbols. A marker such as xxx can be found quickly and without confusion unless your prose tends towards words like *xxxerox*. You can narrow the search by using all caps since the Search function is somewhat case-sensitive for capital letters.

Lee Crisan
Sacramento, California

Actually, you can use a marker of any size as long as it wouldn't appear normally in text. If you use the Alt-S macro shown in Figure 4 to save your work, you can automate the process even more.

After creating the Alt-S macro, create a start-up macro, such as that shown in Figure 5. Since you're not going to invoke it from the keyboard, you might as well name it STARTUP.

Now suppose I saved a text called MYTEXT using the Alt-S macro. If I want to load WordPerfect *and start in the same spot in the document, I can type this on the command line:*

```
WP MYTEXT /M-STARTUP
```

That tells WP *to run the macro STARTUP immediately. If I always want to find the marker, I can put this line in my AUTOEXEC.BAT file:*

```
SET WP = /M-STARTUP
```

That will make WP *always try to find and replace the marker. Of course, if it doesn't find it, there's no harm done.*
—Neil J. Rubenking

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■ EDITED BY ROBERT L. HUMMEL

LANGUAGES

Sideways writing in Turbo Pascal for labeling vertical axes; a filter that gets a copy of the output before it hits the screen; BASIC date functions that make fast calculations.

BASIC

COMPREHENSIVE DATING

At different times I have used date-handling routines from books, articles, and published programs, but I've never found any of these entirely satisfactory. Storage schemes based on bit maps such as

```
DAT% = 512 * Y% + 32 * M% + D%
```

are fast, but elementary questions like "What is the day following DAT%" have complicated answers. On the other hand, methods that arrange successive dates as successive integers are very nice for calculations, but contain lots of If's and loops, making them slow.

I have devised a set of functions that

```
                    FUNCTION EXPLANATION

FnAux1% to FnAux3% are auxiliary functions, not to be used by
the applications program.  1461 is the number of days in four
consecutive years (366 + 3 * 365).  The other strange numbers
come from curve fitting and patching; don't worry about them.

FnMonth.Length%(Y%, M%) returns the length of month M% in year Y%,
for example 30 for M% = 4, Y% = anything.  The year is necessary
to calculate February in leap years correctly.

FnYMD.OK%(Y%, M%, D%) tests the triplet Y%, M%, D% to see if it
corresponds to the year, month and day of a legal date.  It
returns -1 (true) if the date is legal, 0 (false) otherwise.

FnDat$Str.OK%(D$) is a validity test for dates in string format
"MM/DD/YY".  It returns -1 if D$ has the correct format and
legal numerical values.

FnDat.YMD%(Y%, M%, D%) converts any legal date Y%, M%, D% into
an integer X%, according to the following rules:

        Y%  M%  D%          X%
        52  01  01  ->  -17532
        52  01  02  ->  -17531
                        .
                        .
        59  12  31  ->      -1
        00  01  01  ->       0
        00  01  02  ->       1
                             .
                             .
        51  12  30  ->   18551
        51  12  31  ->   18552

Notice:  Years 00 to 51 are assumed to be in the next century (they
         are placed after years 52 - 59)

         The zero of X% has been arbitrarily assigned to the first
         day in the next century:  01/01/00


FnDet%(D$) provides an integer representation for dates given in
"MM/DD/YY" format

FnYear%(X%), FnMonth%(X%) and FnDay%(X%) reconstruct the year,
month and day from the integer X%

FnDat$(X%) reconstructs the string "MM/DD/YY" from X%

FnLongDet$(X%) generates a string representation with the format
"Mmm DD, YYYY" (ie: Feb 26, 1587) for X%

FnDay.Of.Week$(X%) gives the day of the week ("Mon","Tue", ... )
```

Figure 1: *An explanation of the functions in Figure 2.*

```
                    FUNCTIONS AND DEMONSTRATION

Def FnAux1%(X%) = _
    Int(30.61566 * X% - 30.0044 + .2 * ((X% + 9) Mod 12) + (X% < 3))

Def FnAux2%(X%) = _
    Int(X% / 30.41566 + .84488 - .886 * (Int(18.533 + X% / 30.4375) _
    Mod 12) - .83 * (X% < 44))

Def FnAux3%(X%) = X% - 1461 * Int(X% / 1461)

Def FnMonth.Length%(Y%, M%) = _
    31 - Int(Abs(M% - 7.5)) Mod 2 + (M% = 2) * (2 + ((Y% And 3) = 0))

Def FnYMD.OK%(Y%, M%, D%) = _
    (Abs(Y% - 65.5) < 50) And (Abs(M% - 6.5) < 6) And _
    (D% > 0) And (D% <= FnMonth.Length%(Y%, M%))

Def FnDat$Str.OK%(D$) = _
    Mid$(D$, 3, 1) = "/" And Mid$(D$, 6, 1) = "/" And _
    Len(D$) = 8 And FnYMD.OK%(Val(Right$(D$, 2)), _
    Val(Left$(D$, 2)), Val(Mid$(D$, 4, 2)))

Def FnDet.YMD%(Y%, M%, D%) = 1461 * Int((((Y% + 68) Mod 100) _
    - 68) / 4) + FnAux1%(12 * (Y% And 3) + M%) + D% - 1

Def FnDat%(D$) = _
```

(continues)

Figure 2: *A comprehensive set of BASIC date manipulation functions.*

■ LANGUAGES

```
    FnDat.YMD%(Val(Right$(D$, 2)), Val(Left$(D$, 2)), _
    Val(Mid$(D$, 4, 2)))

Def FnYear%(X%) = _
    ((100 + 4 * Int(X% / 1461)) Mod 100) + _
    Int(FnAux2%(FnAux3%(X%)) / 12)

Def FnMonth%(X%) = (FnAux2%(FnAux3%(X%)) Mod 12) + 1

Def FnDay%(X%) = _
    FnAux3%(X%) - FnAux1%(1 + FnAux2%(FnAux3%(X%))) + 1

Def FnDat$(X%) = _
    Right$(Str$(100 + FnMonth%(X%)), 2) + "/" + _
    Right$(Str$(100 + FnDay%(X%)), 2) + "/" + _
    Right$(Str$(100 + FnYear%(X%)), 2)

Def FnLongDat$(X%) = _
    Mid$("JanFebMarAprMayJunJulAugSepOctNovDec", 3 * _
    FnMonth%(X%) - 2, 3) + " " + Right$(Str$(100 + _
    FnDay%(X%)), 2) + ", " + Right$(Str$(FnYear%(X%) + _
    2000 + 100 * (X% < 0)), 4)

Def FnDay.Of.Week$(X%) = _
    Mid$("SatSunMonTueWedThuFri", 3 * (X% - 7 * Int(X% / 7)) + 1, 3)
Input "Input a date in MM/DD/YY format: "; D$
If Not FnDatStr.OK%(D$) Then Beep : End

X% = FnDat%(D$)
Print
Print "The expanded form of this date is: " FnLongDat$(X%)
Print "The corresponding day of the week: " FnDay.Of.Week$(X%)
Print "       The date 90 days before is: " FnDat$(X% - 90)
Print "          The date 150 days after: " FnDat$(X% + 150)

Y%  = FnYear%(X%)
M%  = FnMonth%(X%)
D%  = FnDay%(X%)
ML% = FnMonth.Length%(Y%, M%)

Print "     The last day in the month is: " FnDat$(X% - D% + ML%)
Print "  The first day of the next month: " FnDat$(X% - D% + ML% + 1)

LF% = X% - D% + ML%
While FnDay.Of.Week$(LF%) <> "Fri"
  LF% = LF% - 1
Wend
Print "  The last friday in the month is: " FnDat$(LF%)

FM% = X% - D% + 1
While FnDay.Of.Week$(FM%) <> "Mon"
   FM% = FM% + 1
Wend
Print " The first monday in the month is: " FnDat$(FM%)
```

(Figure 2 ends)

have the convenience of being of the "next day, next integer" type, but without requiring any loops or iterations. Figure 1 gives a brief explanation for the functions, and Figure 2 demonstrates each one in context.

Thomas P. Eggarter
San Luis, Argentina

These functions are constructed using the "older" form needed by the BASIC interpreter, where all statements must be contained on a single program line. Remember that under most versions of BASIC (though not Turbo Basic), functions must be defined before they are referenced in the program.

To enhance clarity, I divided some of the longer definitions into multiple lines using the underscore line continuation character. Since this type of function can't take advantage of If/Then testing, Boolean logic is used instead. When you see a statement such as (X% < 0), this will be treated in the function calculation as either 0 or −1, depending on whether X% is actually less than 0.—Ethan Winer

TURBO PASCAL

SOME WRITING ON THE SIDE

In the past I have labeled the vertical axis of plots produced by Turbo Pascal graphics routines using vertically oriented letters. Some characters like "(" and "," lose a lot of appeal when they occur in a one-character-wide vertical column. The Side_Write procedure (Figure 3) writes the first 128 ASCII characters to Turbo's HiRes screen at an orientation 90 degrees counterclockwise from normal.

A table starting at memory location F000:FA6E describes these characters, giving 8 bytes to each. Side_Write reads the description into an 8-byte array and then calls Turn_Left, which returns the array with the rotated character's description. It then writes the character to the HiRes screen memory at user-specified screen coordinates. The resulting characters are somewhat squatty but legible. Incidentally, it's a simple matter to orient characters upside down or at 270 degrees counterclockwise by making two or three calls to Turn_Left.

Marvin Larsen
Albuquerque, New Mexico

I thought it a shame that the Side_Write procedure only works in HiRes mode, so I

```
{$R+,C-}
PROGRAM Side_Write_Demo;
TYPE
  letter = ARRAY[0..7] OF Byte;
VAR
  j, k : Integer;

  PROCEDURE Turn_Left(VAR Character : letter);
  (* Turn_Left does the arithmetic to "rotate" the character. *)
  VAR
    New_Character : letter;
    i, j : Integer;

  BEGIN                          (* Procedure Turn_Left *)
    FOR i := 0 TO 7 DO
      BEGIN
        New_Character[i] := 0;
        FOR j := 0 TO 7-i DO
          New_Character[i] := New_Character[i]+
          (1 SHL(7-j-i))*((1 SHL i) AND Character[j]);
        FOR j := 7-i+1 TO 7 DO
          New_Character[i] := New_Character[i]+
          (((1 SHL i) AND Character[j]) SHR(i-7+j));

      END;                       (* i-loop *)
    FOR j := 0 TO 7 DO
      Character[j] := New_Character[j];

END;                             (* Procedure Turn_Left *)

(* Side_Write:
   1) Receives the desired character and its screen coordinates,
   2) Reads the description of the character from memory,
   3) Calls Turn_Left to rotate the character, and
   4) Writes the rotated character to screen memory          *)

PROCEDURE Side_Write(x, y : Integer; (* Coordinates for character *)
                     let : Char (* Desired character          *) );
VAR
  Seg, Off, k : Integer;
```

(continues)

Figure 3: *Routines to write sideways in HiRes mode.*

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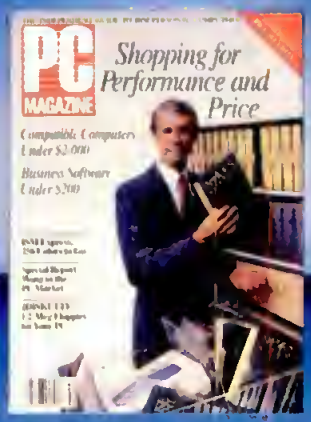

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```
  Character : letter;
  Character_Set : ARRAY[0..127] OF letter ABSOLUTE $F000 : $FA6E;

BEGIN                          (* Procedure Side_Write *)

  FOR k := 0 TO 7 DO Character[7-k] := Character_Set[Ord(let), 7-k];

  Turn_Left(Character);

  FOR k := 1 TO 4 DO
    BEGIN                      (*   write new character to screen memory  *)
      Seg := $B000;
        off := x+80*(k-1+4*y);
        Mem[Seg:off] := Character[(k-1)*2];
        Seg := $BA00;
        Mem[Seg:off] := Character[k*2-1];
      END;
  END;                         (* of Side_Write *)

BEGIN                          (*main*)
  ClrScr;
  HiRes;
  (*  write 8 columns of 16 characters to display rotated character set *)
  FOR j := 1 TO 8 DO
    FOR k := 0 TO 15 DO side_write(j*2, 20-k, Chr((j-1)*16+k));
  REPEAT UNTIL KeyPressed;
  TextMode;
END.
```

(Figure 3 ends)

```
PROCEDURE Side_Write(x, y : Integer; (* Coordinates for character *)
                     let : Char; (* Desired character   *)
                     col : byte); (* Desired color (0-3) *)
VAR
  Seg, off, k : Integer;
  Character : letter;
  Character_Set : ARRAY[0..127] OF letter ABSOLUTE $F000 : $FA6E;
CONST
  colors : array[0..3) of integer = (0,$5555,$AAAA,$FFFF);

  FUNCTION Expand(e : byte) : integer;
  VAR bit : byte;
    temp : integer;
    X : 0..1;
  BEGIN
    temp := 0;
    FOR bit := 0 to 7 DO
      BEGIN
        X := (B and (1 shl bit)) shr bit;
        temp := temp + (e shl (2*bit)) + (X shl (2*bit+1));
      END;
    Expand := swap(temp) AND colors[col];
  END;

BEGIN                          (* Procedure Side_Write *)

  FOR k := 0 TO 7 DO Character[7-k] := Character_Set[Ord(let), 7-k];

  Turn_Left(Character);

  FOR k := 1 TO 4 DO
  BEGIN  (*   write new character to screen memory  *)
    Seg := $B000;
    off := 2*x+80*(k-1+4*y); {change "x" to "2*x"}
    MemW[Seg:off] := expand(Character[(k-1)*2]); {change Mem to MemW}
    Seg := $BA00;
    MemW[Seg:off] := expand(Character[k*2-1]);   {change Mem to MemW}
  END;
END;                           (* of Side_Write *)
```

Figure 4: *A version of Side_Write for GraphColorMode.*

created an alternate version for GraphColorMode (Figure 4). In this medium-resolution mode, each pixel gets two bits and, thus, can take any of four colors (00, 01, 10, or 11). The first step is to expand each byte of information into an integer, with two bits of the integer corresponding to every one of the byte. For example, 01000001 becomes 0011000000000011.

If we left the expansion at this point, it would always write in color 3—both bits on for every pixel. In order to use color 2, we must turn OFF every odd numbered bit. We can do this by ANDing the integer with the binary value 1010101010101010, or $AAAA. For color 1, we turn off the even-numbered bits with the value 0101010101010101, or $5555. The array Colors contains the appropriate bit masks for colors 0 through 3.

Note that if you use the modified Side_Write in GraphColorMode, you must supply one more parameter at each call. This final parameter determines the color of the character.—Neil J. Rubenking

FILTERING OUTPUT

TEE (Figure 5) is a UNIX-style filter for PC-DOS. It takes one parameter, the name of an output file. Input is redirectable, and output will go both to the output file and to standard output, as shown in the diagram "TEE's Input and Output."

To display and copy a text file at the same time,

```
TEE 2ndFile < 1stFile
```

is equivalent to executing

```
TYPE 1stFile
COPY 1stFile 2ndFile
```

simultaneously. Or you could make two copies at once with

```
TEE 2ndFile < 1stFile > 3rdFile
```

```
{$G4894,P4496,D-,R+}
(* Compiler directives for TurboPascal Ver 3.0     *)
(* Change the $G & $P set the I/O buffer sizes     *)
(* Use larger number to speed up filtering process *)
PROGRAM TEE_Filter;
VAR
  OutF : Text;
  Ch : Char;

  FUNCTION CheckAndInit : Boolean;
  BEGIN
    IF ParamCount <> 1 THEN
      BEGIN
        CheckAndInit := False;
        WriteLn(Con,'TEE Ver 1.0 by T.S. Teo Jan 1987, Singapore');
        WriteLn(Con,'Usage: "TEE FileName". TEE is to be used as a filter.');
      END
    ELSE
      BEGIN
        CheckAndInit := True;
        Assign(outF, ParamStr(1));
        Rewrite(outF);
      END;
  END;

BEGIN                          (main)
  IF CheckAndInit THEN
    BEGIN
      WHILE NOT EoF DO
        BEGIN
          Read(ch);
          Write(ch);
          Write(OutF, ch);
        END;
      Close(OutF);
    END;
END.
```

Figure 5: *A UNIX-style TEE filter in Turbo Pascal.*

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■ LANGUAGES

You could issue a command like

```
Dir | find "AFILE"
```

to locate a particular file. But what if you want to intercept the filtering process and get a copy of the output of DIR before it is piped to FIND? You could do it with

```
Dir | TEE DIR.OUT | find "AFILE"
```

Now you have DIR.OUT, output of DIR, at the same time the output is still piped to FIND to locate the file "AFILE".

NOTE that TEE will always create or overwrite the output file. Also, standard UNIX switches like -i and -a are not supported in the current version of TEE.

Tat-Khai Teo
Singapore

You can do some wild things with filters. For example,

```
TEE news.out < news.in | find "Rubenking" >>
 news.out
```

will make a copy of the file NEWS.IN with every line that contains my name duplicated at the end. (Be sure to type this command all on a single line.) It's easy to write filters in Turbo Pascal using the PG compiler options.

TEE's Input and Output

TEE's input is redirectable, and its output will go both to the output file and to standard output.

However, even though the Pascal source is small, the programs will be at least 11.5K. That's the size of the Turbo Runtime Library. But there's hope—the new Turbo Optimizer from TurboPower Software reduced TEE.COM from 11,708 bytes to 3,442. If you have the Optimizer, filters in Turbo are more inviting than ever.

Note one important point—the error messages in Function CheckAndInit go to the CON device. Even if standard output is redirected to another device, these messages will show up on the screen.

—Neil J. Rubenking

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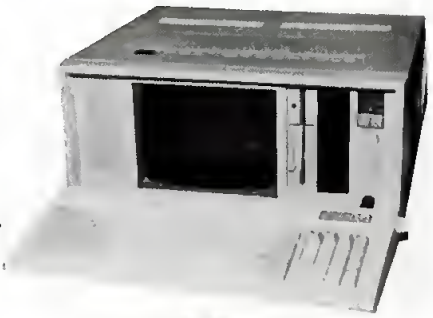

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■ ROBERT L. HUMMEL

PC TUTOR

How the EGA makes slowpokes out of many systems; hard disks picking up bad vibrations; blurry mono text with the CGA; why assembler macros are useful, but confusing.

MACROS IN ASSEMBLER

I'm just starting to learn assembly language, and I find the productivity articles informative and helpful. I have one question, however, regarding the programs you print. Why don't the programmers use macros in their programs? They would seem to be more logical in some cases.

Jon L. Anderson
Virginia Beach, Virginia

In common use among computer owners, the term macro *has come to mean any method that allows repetitious tasks to be abbreviated. Keyboard macros let you use simple key combinations, like Alt-A, to substitute for lengthy sets of commands and text. Some applications have a macro language that is sophisticated enough to allow conditional statements and operations that branch depending on user input. Macros are used in assembly language programming for many of the same purposes: to communicate with MASM, the assembler program, and to save the programmer time.*

Using macros can save time and make assembly programming easier by making a cryptic sequence of machine instructions somewhat self-documenting. A single programmer using a set of personally developed macros can recognize a significant increase in efficiency. Large groups of programmers, working on a single project, can use a library of macros to increase compatibility of their individual efforts. So macros in assembler, on the whole, appear to be a desirable thing. Why, then, don't we use them in PC Magazine*'s Productivity section?*

Since macros are abbreviations, they must be used only when the full meaning is clear. For many readers, assembly language is difficult enough to understand without having to learn a new and possibly different set of abbreviations for each program.

Sometimes, however, a substitution-type macro makes reading source code easier. For example, the character 13, when printed, causes the cursor to return to the left side of the screen. Often the macro name "CR" (which stands for carriage return) is used to represent this character. Similarly, the character 10, a line feed, is represented by "LF." Thus, by substitution, you get the statement

```
MSG     DB      "Error!",CR,LF
```

Macros are not limited to such simplicity, however, and can be amazingly complex. Macros can take arguments, loop, repeat, nest, and allocate storage. The more complex a macro, the more likely it is to confuse both the reader and the staff at the magazine who must test and understand the code.

If enough macros and substitutions are used, the assembly code will become verbose and read like a high-level language. But the structure will remain the same. There should be no shame in programming in assembler and having it appear that way. Creating macros that are as complex as subroutines is a challenging and worthy accomplishment, but use restraint if you want your code to be read and understood by others.

■ Macros in assembler, on the whole, appear to be a desirable thing. Why, then, don't we use them in *PC Magazine*'s Productivity section?

ENVIRONMENT STRINGS

I want to use an environment variable that I set to either YES or NO to control flow in a batch file. I've tried several methods, but none of the logical combinations seem to work. It seems to me that there should be a way to test environment strings in batch files.

Tom Grahn
Westmont, Illinois

Although not prominently featured in the DOS manual, there is a known and reliable method for using environment strings in batch files. To identify a string as a variable name, you just enclose it between percent symbols. When the batch file is executed, the string stored in the environment will be substituted for the variable. To demonstrate, put the variable TUTOR into the environment by typing the following line at the DOS prompt:

■ PC TUTOR

```
SET TUTOR=YES
```

Be sure to leave no spaces on either side of the equals symbol. Now create a batch file to test the value stored in the environment by entering the following lines at the DOS prompt. To create the Ctrl-Z (^Z), press the F6 key or press and hold the Ctrl key while tapping the Z key once.

```
COPY CON TUTOR.BAT
IF %TUTOR%==YES ECHO TUTOR WAS YES
IF %TUTOR%==NO ECHO TUTOR WAS NO
^Z
```

DOS should reply "1 File(s) copied." Now execute the batch file by typing TUTOR and pressing the Enter key. If all went well, you should see the message "TUTOR WAS YES". Now change the value of the variable by entering

```
SET TUTOR=NO
```

When you execute TUTOR again, the message "TUTOR WAS NO" is displayed.

BOUNCING HARD DISKS

I purchased an IBM PC-XT with a 20MB hard disk and an NEC 3550 printer about 2 years ago. All the equipment is mounted on a desktop workbench, and during a printout, the computer sits idle except for an occasional hard disk access to get text.

The 3550 is a noisy beast, but worse than that, the vibration the machine puts out is tremendous. After reading the *PC Magazine* issue on hard disks (June 9, 1987), I have become concerned about this vibration. Could the printer be bouncing the hard disk head over the magnetic medium to the point of possible destruction? Is there a means of inhibiting the vibrations? Would a printer enclosure help?

Paul K. Johnson
Aurora, Illinois

Printers (such as the NEC 3550) that use mechanically driven print heads do produce significant amounts of noise and vibration while operating. The print heads are moved rapidly between character locations and must be stopped abruptly before the character is hammered onto the paper. Large motors are employed to move to the left and right margins, some of them drawing as much power as a small air conditioner. The resulting movement can often rock the entire printer.

There is no doubt that the vibration from a printer is potentially hazardous to the health of your hard disk. The magnetic platters in the hard disk spin at between 3,000 and 3,600 RPM and develop an amazing amount of gyroscopic inertia. As long as the computer is kept stationary, this property produces no physical ill effects. But if it is moved, each action produces a reaction that puts strain on the spindle and bearings inside the disk. In addition, the heads can bounce, affecting alignment, and in severe cases may actually contact and damage the disk surface.

A soundproofed enclosure cuts down on the noise produced by the printer, but does little for the vibration problem. Placing a thick, rubberized pad underneath the printer will cut down on the shock transmitted to the workbench, but may cause problems with inadequate ventilation. The safest solution is to move the printer to another location where the vibration won't be conducted to the hard disk.

OFF-COLOR MONITORS

My computer has an IBM CGA–compatible color card driving a monochrome monitor via the composite video jack. Unfortunately, when I run some software applications, a color card is detected and the result is a combination of unreadable and washed-out text. Is there any way to ensure clear monochrome displays with a color card and composite monitor?

John W. Carrier
Avon, Connecticut

The Color/Graphics Adapter (CGA) is the only IBM video card available for the PC that offers both an RGB (red, green, blue) digital output and a composite video output. IBM's intent was to provide a method for coupling the output of the CGA to a home television set through an RF modulator, as early video games did. The video output is a standard composite monochrome signal with the color information encoded in the "colorburst."

The CGA card requires a color monitor, which costs about $350. Monochrome monitors were, and still are, inexpensive by comparison. Digital monochrome monitors, however, like those that connect to the IBM Monochrome or Hercules graphics cards, will melt and burn up if connected to a CGA card. Don't try it! Monochrome monitors designed to work with a composite input and selling for under $100 were seen as a low-cost way to have the best of two worlds. They saved money while allowing CGA graphics displays.

But the CGA/monochrome composite combination has a few drawbacks. If the colorburst signal is active, the screen often becomes blurred and fuzzy. In addition, certain color foreground/background combinations may not show up in mono, even if they appear fine in color.

Because there are so many ways to create screen output, there is no general-purpose method that will prevent software from using colors when writing on the screen. Characters placed on the screen through the BIOS can be trapped and changed to monochrome, but programs that write directly to screen memory will still succeed in creating unreadable displays. And applications that reset the video mode based on the presence of a CGA will inevitably reenable the colorburst.

EGA DOLDRUMS

I have two AT clones at work. The first has a Hercules monochrome graphics card and a 20MB hard disk rated at 80 milliseconds. The second has an NEC GB-1 EGA card and a 40MB hard disk rated at 40 ms. Otherwise, they are identical.

When I list a typical directory on both disks, the screens display faster on the first AT, the one with the slower hard disk! The second AT also takes longer to boot, from either a cold start or a Ctrl-Alt-Del restart. Are the color monitor and EGA board slowing down the screen output?

Larry Neinstein
Studio City, California

On a system that contains a Monochrome Display Adapter (MDA), Hercules Graphics Adapter (HGA), or Color/Graphics Adapter (CGA), the program code that produces the characters on-screen is contained in the main BIOS chip on the motherboard. The speed of the display is controlled by how well these routines are written and is generally independent of the manufacturer. Because of differences in design, the monochrome monitor will appear faster than the CGA.

The Enhanced Graphics Adapter (EGA), hawever, is a harse af a different calor. Precisely because it has enhanced capabilities, the EGA card tends to be slower; power does nat come without a price. Because af the added complexity, many more parameters must be checked and calculatians made.

Ta implement this new hardware, the EGA cames with its own extensian ROM an the adapter card that replaces the BIOS videa routines. The ROM cantains new code that is executed every time a video call is perfarmed. The situatian is aggravated for cards that emulate modes ather than EGA. In addition ta the normal tests, these cards must constantly ask if they are in a special mode, and if sa, haw ta handle it. The result is videa daldrums.

Adding further frustration is the additianal delay caused by the POST (Pawer-On Self Test) for the adapter that is perfarmed when the PC is turned an. Usually this test is perfarmed only far the initial power-on and ignared for warm boots. But same manufacturers' versians of the EGA may take slightly langer because af a bug that farces the PC to cold-boot each time. (See "Achieving the Standard: 12 EGA Boards," PC Magazine, August 1986.)

Because each manufacturer writes its awn BIOS, the quality af the EGA code varies greatly. The subjective speed af a PC is averwhelmingly influenced by the performance of the videa system. Poor code, badly implemented, can make even 80386 machines appear to slaw to a crawl.

This is exactly the type of situation where a comparative benchmark pragram like the PC Labs Benchmark Test cames in handy. These tests, available for downloading free of charge from the IRS, will give you a clear indicatian af the performance of each af your videa subsystems.

ASK THE PC TUTOR

The PC Tutor solves practical problems and explains points of general interest about using your hardware and software more productively, and answers basic questions about DOS and systems in general. To see your questions answered here, drop a line to PC Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016. We're sorry, but we cannot answer questions personally.

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Christopher O'Malley
PERSONAL COMPUTING, April '86

PC MAGAZINE "Because copy protection can interfere with the ability to back up a hard disk, business-oriented users may prefer programs like TranSec's UNlock series."
Winn L. Rosch
PC MAGAZINE, May 27, 1986

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Jerry Poumelle, BYTE, Feb. '86

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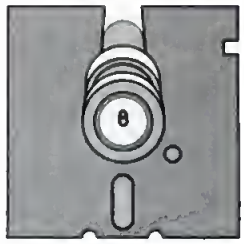

Overnight file-serving from a DEC VAX; industrial-strength LANs for noisy factories; receiver overruns and thwarted escape sequences; DOS batch file primers.

BATCH FILE STARTERS

In several of your articles on LANs, you stress the need to understand how to write DOS batch files. We see how batch files make the network easier to use, but we don't understand all the percent signs, greater-than signs, and other symbols. Can you point us toward a good book, course, or other method of learning how to write batch files?

William Deloney
Phoenix, Arizona

For starters, the Productivity section of every issue of PC Magazine *contains examples and explanations of batch files designed for all kinds of jobs. Over time, these columns provide the best programming examples available anywhere.*

However, since you are looking for material organized according to a lesson plan, I have several suggestions. First, be careful when you buy books on DOS. Stand at the book rack and take time to look at the level and style of the books. There are several good ones. One you might choose is The MS-DOS Handbook, *written by Allen King and published by Sybex. Van Wolverton's original book,* Running MS-DOS, *is also a good starting point. Despite its alluring name, I was disappointed by* Tricks of the MS-DOS Masters, *written by Angermeyer et al. and published by Howard W. Sams. It has great shelf appeal (even at $24.95), but we seldom find answers to our questions in it.*

But overall, books are a dull way to learn DOS. Two other alternatives are more expensive but also more effective.

Learn-PC Video Systems (tel. (800) LEARN-PC) markets a package of three videotapes called DOS for Hard and Floppy Disk Users *with several good sections on batch files. The package includes demonstration disks and guidebooks that are used along with the taped presentation. Five hours of instruction plus practice make savvy DOS users out of novices.*

Once you buy the tape set, you can use it over and over again to train new people. That's good because it costs $895 in VHS or Beta format.

A much less expensive aid is a clever program from Boston Documentation Design (tel. (617) 965-5399). Its BOSTON .DOC for MS-DOS is a memory-resident program that (the manufacturer claims) equals a 250-page reference manual. For $34.95 (and the loss of 120K), you get an on-line reference with fast lookup, excellent explanations, and cross-references that is always handy when you need it. BOSTON.DOC includes on-line explanations of the use of %, >, >>, and many other batch file commands. We use it and like it.

■ Once you buy the DOS tape set, you can use it over and over again to train new people. That's good because it costs $895 in VHS or Beta format.

GARBLES AND OVERRUNS

I'm trying to run the VAX editor EDT, and I keep getting parts of escape sequences on the screen. The data on the screen is garbled. My terminal emulation package reports that I'm getting "receiver overruns."

Randy Grimm
Peterborough, New Hampshire

A receiver overrun means that a character from the host computer was lost. If an escape character was lost, the remaining characters in the sequence are treated as normal data displayed on the screen. Receiver overruns are often caused by memory-resident software that holds off interrupts for too long. Since most high-performance terminal emulation software is interrupt driven, turning off interrupts for more than $^{1}/_{1,000}$ of a second means you cannot reliably communicate at speeds of 9,600 bits per second (1,000 characters per second). I recommend renaming your AUTOEXEC.BAT and CONFIG.SYS files and rebooting your PC to see if dropping out added drivers, environments, and memory-resident programs clears up the problem.

HOST-INITIATED FILE TRANSFER

Your review of the DEC VAX as a file server for MS-DOS PCs ("Making Connections: DEC Meets DOS," *PC Maga-*

■ CONNECTIVITY CLINIC

zine, September 29, 1987) was very useful. I'd like to have our DEC VAX computer access a number of remote PCs and download files at night. Are you aware of any particular brands of software that might support this kind of thing, or would it be necessary for me to write a custom application?

Jerome Landry
Montgomery, Alabama

Products such as PCTerm, *by Crystal Point*, SmarTerm 100, *by Persoft*, Crosstalk, *by Microstuf, and* Reflection, *by Walker Richer and Quinn, all provide for unattended operation, including reception of files. The PC must be turned on and running the terminal emulation software. Depending on the implementation, the host computer may issue commands on the PC by sending special character sequences to the communications software. If the PCs are remote, you will have to configure the modem to auto-answer. You still have to find or write the software in order for the host to dial the modem and initiate the connection. However, it is likely that a version of Kermit is available for your DEC hardware-and-operating-system combination.*

■ I'd like to have our DEC VAX computer access a number of remote PCs and download files at night. Are you aware of software for this?

SOFTWARE LAN-ANALYSIS TOOLS? Over the past few months you have written some great networking articles for *PC Magazine*. I'm impressed with the depth of the articles and the amount of information.

The company that I work for writes networking software for the factory environment. The factory network poses some interesting problems. The problem we are most concerned with is electrical noise on the network cables from the machines around the workstation.

We would be interested in any information you have about noise on the network cables, diskless workstations, and fiber-optic LANs. We also need to know about software LAN-analysis tools. The Ethernet Analyzer is a little overkill for us.

Jay Taylor
Eden Prairie, Minnesota

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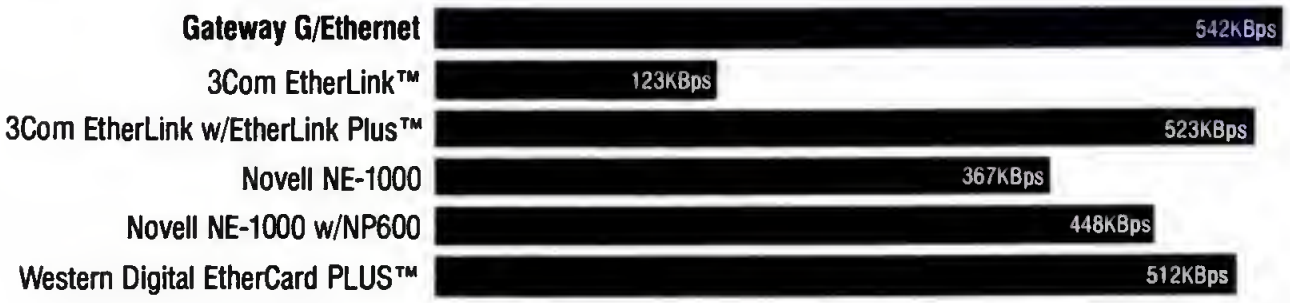

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right answer. See my reviews in "Making Connections: Fiber-optic LANs" (PC Magazine, *January 12, 1988).*

In "Making Connections: LAN Analyzers" (PC Magazine, *December 22, 1987), we reviewed LAN analysis tools, including 3Com's* EtherProbe Network Utility, *a software product for analysis of Ethernet networks. See "Equipping Your Network: The LANstation Alternative"* (PC Magazine, *May 26, 1987) for the full rundown on diskless workstations. You are going to force me to publish a "Connectivity Index."*

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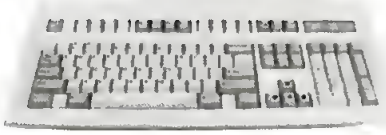

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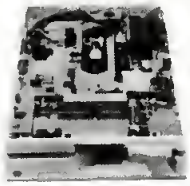

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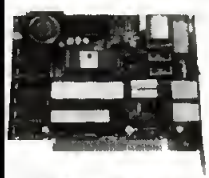

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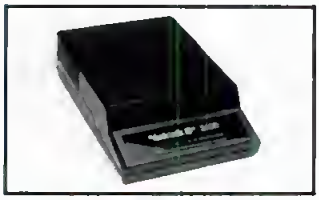

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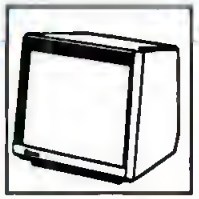

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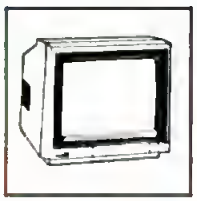

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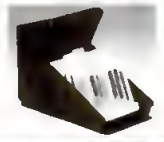

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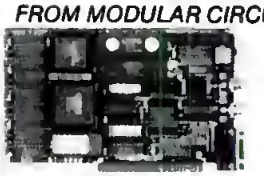

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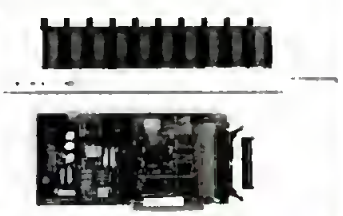

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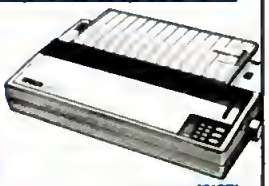

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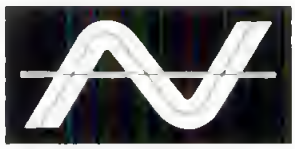

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STANDARD NORTHGATE SUPER/TURBO 286-60 "E/T" SPECIFICATIONS:

PROCESSOR	INTEL 80286
PROCESSOR SPEED	8/12 MHz 1 WAIT
MAKE OF BIOS	AWARD W/SETUP IN ROM
EXPANSION SLOTS	8 (TWO 8 BIT, SIX 16 BIT)
STANDARD MOTHERBOARD MEMORY	1 MEGABYTE 120NS
CO-PROCESSOR SLOT	YES
CLOCK-CALENDAR	YES WITH AA BATTERIES
NO. OF FLOPPY DRIVES	2—1.2MB and 360K
(NOTE: 3 EXPOSED HALF HEIGHT DEVICES MAY BE INSTALLED)	
BRAND OF FLOPPY	FUJITSU
NO. OF HARD DRIVES	1 (SPACE FOR TWO)
TYPE OF HARD DRIVE	MINISCRIBE MODEL 3650
HARD DRIVE FORMATTED	64.2 MEGABYTES USABLE
STD. MONITOR TYPE	SAMSUNG 12" AMBER TTL
STD. VIDEO CONTROLLER	HERCULES COMPAT. 1 P.P.
ADDITIONAL PORTS STANDARD	1 P.P., 1 S.P., 1 G.P.
KEYBOARD TYPE	ENHANCED 101 CLICK TYPE
MS-DOS 3.2 & GWBASIC	WITH HARD COVER MANUALS
CASE—FULL SIZE (NOT BABY AT)	HAS CONTROL PANEL, LED'S AND SECURITY KEYLOCK

SUPER/TURBO 286-60 "E/T" SYSTEM PRICE COMPLETE $1999.00

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CIRCLE 240 ON READER SERVICE CARD

Northgate's V20/8MHz XTurbo Is Now Available with 65MB Hard Drive and the same "Enhanced Technology"

NOW...for the buyer who doesn't need 286 speed but wants an XT type system with through-put up to four times faster than other systems, Northgate offers its XTurbo/V20/8-65.

This system also features the MiniScribe hard drive and SMS high speed controller. It is furnished complete with:

V20 Microprocessor • 640K Memory on Motherboard • 360K Floppy Drive • MiniScribe 60MB FAST Hard Drive with 1:1 interleave • 8 Expansion Slots • 2 Parallel, 1 Serial Port, Clock-Calendar, Game Port • Amber Screen TTL Graphic Monitor with Hercules Compatible Video Card • Northgate "C/T" Click-Tactile 84-key AT style keyboard • Case is the AT style with turbo button, keylock reset button and indicator lights. *(Second Floppy Drive pictured is optional at additional cost.)*

Complete System Price: $1299.00

Same system with 30MB Hard Drive $1149.00

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Northgate guarantees its systems will operate any standard, commercially available DOS programs written for use on IBM Compatible Computers. If, on consultation with Northgate, a program cannot be made to operate satisfactorily, owner may return the system, complete and unaltered for a prompt and full refund including all freight costs.

One-Year Overnight AT NORTHGATE EXPENSE Parts Replacement Warranty:
Northgate Computer Systems warrants that all systems sold by Northgate will be free of defects in workmanship and materials for one year from date of shipment.

In the event of failure of a part that disables the system Northgate will ship, the same day if notified by 12 Noon Central Time, a new replacement part. Customer must phone Northgate Customer Service for diagnosis of the failure.

Shipment of the replacement part will be by overnight express service—AT NORTHGATE'S EXPENSE—for next day delivery depending on the carrier's ability to provide such service in owner's geographic area.

Owner must return any replaced part, complete and unaltered, and pay return shipping costs, to be received at Northgate within two weeks after receiving the replacement part.

Northgate's Customer Service department will provide full instructions on making the repair or replacement and will consult with customer on the phone to assure repair is properly completed and the system is again operating.

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CIRCLE 241 ON READER SERVICE CARD

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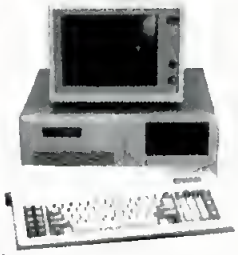

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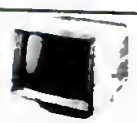

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Modem		2400B & SW	$149
T1100/T3100/Z181	$109	Toshiba 3.5" XT/AT	
Panasonic Fax	Call	720k Drive	$115
		US Robotics	
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CIRCLE 387 ON READER SERVICE CARD

HOW TO SUCCESSFULLY BUY THROUGH MAIL ORDER AND PROTECT YOUR RIGHTS

Mail order sales are governed by rules of the Federal Trade Commission (FTC) and various state laws. These guidelines are published as a service to you. Remember, the many vendors advertising in PC Magazine are eager to serve your needs.

FTC rules say:

1. The Seller must ship your order within 30 days of receiving it, unless the advertisement clearly states it'll take longer.

2. If it appears that your order will not be shipped when promised, the Seller must notify you in writing in advance of the promised date, giving a definite new date, if known, and offering you the opportunity to cancel the order with a refund or consent to a definite delayed shipping date or an indefinite delay.

3. The Seller's notice must contain a stamped self-addressed card or envelope with which you can indicate your preference. If you don't respond to this notice, the Seller may assume you agree to the delay, but must either ship or cancel your order within 30 days after the original shipping date promised or required. A prompt refund must be made when an order is cancelled.

4. Even if you've consented to an indefinite delay, you retain the right to cancel the order at any time before the item has been shipped.

5. If you choose to cancel an order, that has been paid for by check or money order, the Seller must mail you a refund within seven business days. If you cancel an order for which you paid by credit card, the seller must credit your account within one billing cycle following receipt of your request. Store credits or vouchers in place of a refund are not acceptable.

6. In the event that the item you ordered is unavailable, the Seller may not send you substitute merchandise without your express consent.

TIPS WHEN ORDERING

When ordering by mail:

State precisely what merchandise you want, specifying details such as model, make, size, component parts, etc.;

Confirm the price and expected delivery date as stated in the ad;

Indicate whether you will accept a substitute product if the item you ordered is unavailable, and, if not, that your payment should be returned;

Don't send cash, you will have no record of payment if a problem arises, and;

Keep a copy of your order and all other correspondence with the Seller. Your records should include the company's name, address and phone number; a description of the item ordered; your cancelled check or a copy of the money order; record of the date you mailed the order; and any sales slips and shipping receipts.

When ordering by phone:

Note the time and date of your conversation and the name of the person you talk with;

Make a record of your order, the price, its promised availability and the components to be expected;

Save all correspondence associated with your order, including your cancelled check or a copy of the money order, and any written confirmation sent by the Seller.

Questions you should consider asking:

Does the advertised item come with all necessary parts and accessories? Are they from the same manufacturer?

Is it available for immediate shipping?. If not, when will it be available?

Has there been an increase in the advertised price?

What warranties does the item carry? Who provides the service?

What is the Seller's return policy?

What is the Seller's refund policy?

With whom should you correspond if there is a problem?

IF YOU HAVE PROBLEMS:

1. If you have not received your order as promised or if the item is defective, immediately notify the Seller in writing referring to your order by description, price, date, as well as by account number and order number, if available. Make sure you keep a copy of the letter.

2. If you complain by telephone, send a follow-up letter to confirm what was said.

3. If you think the merchandise is defective, reread your product instructions and your warranty carefully to be sure you don't expect features or performance the product isn't designed to give. Then contact the Seller for instructions. Don't return it to the Seller until you have been instructed to do so.

4. When returning merchandise make sure you keep the shipper's receipt or packing slip; your right to be reimbursed for postal cost is determined by store policy.

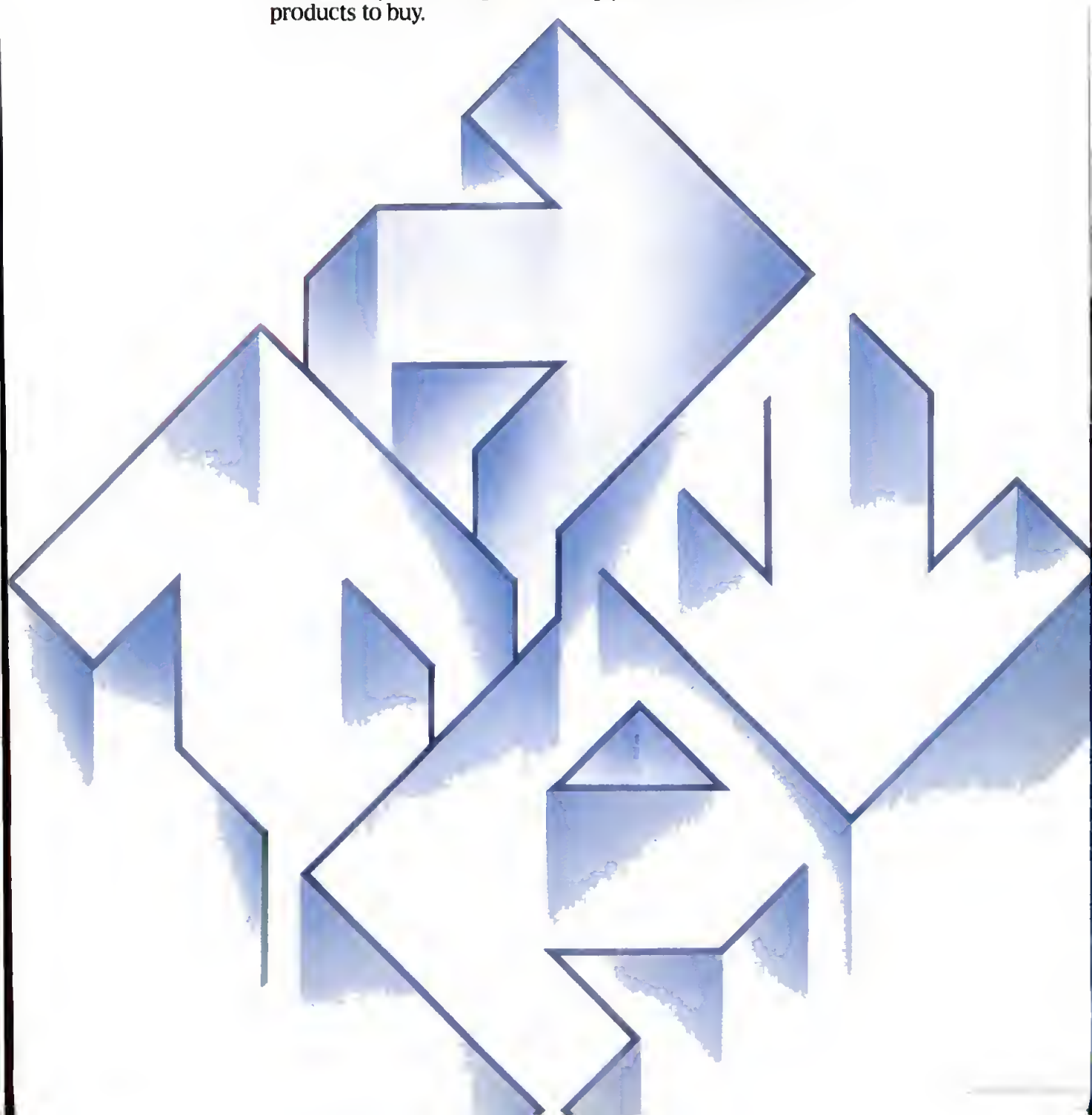
5. If you have completely discussed your problem with the Seller and are still not satisfied, write to the consumer complaint agency in the Seller's state. If you paid for the merchandise by credit card, you may have rights to withhold payment under a Federal law called the Fair Credit Billing Act.

PC MAGAZINE

Marketplace

The PC Buyers Guide to Products and Services

This is your showcase—your direct source of information on PC products and services. PC Magazine Marketplace gives you quick access to exactly what you're looking for, plus information regarding price, discounts, specifications and delivery. Use this guide to help you decide which products to buy.



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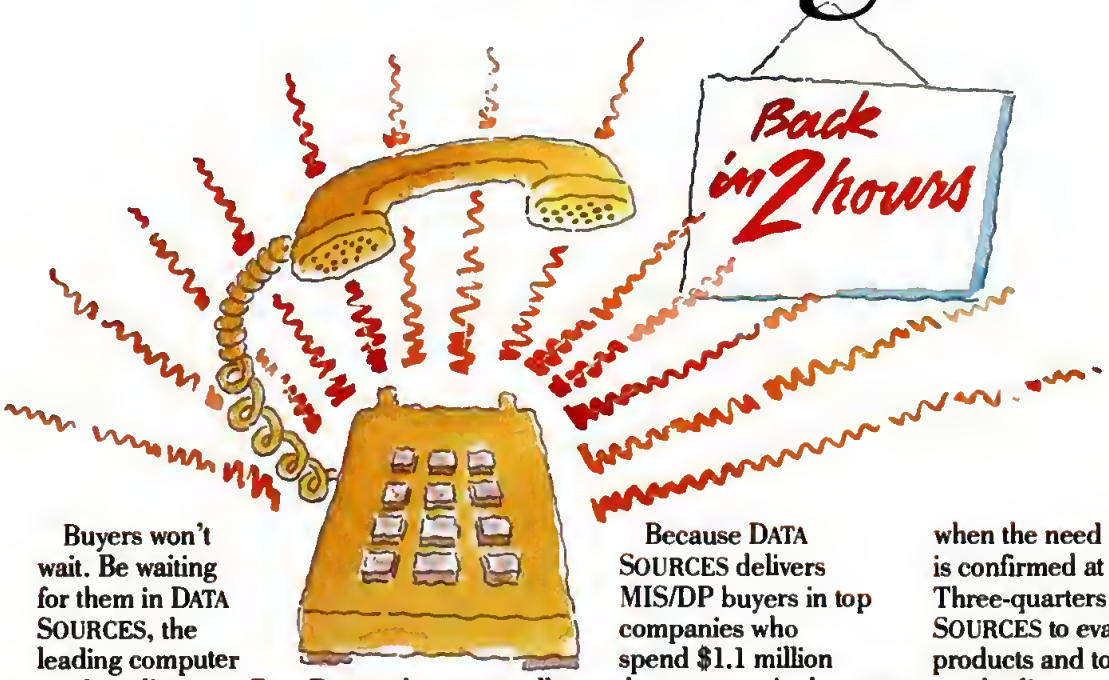

Buyers won't wait. Be waiting for them in DATA SOURCES, the leading computer product directory. Beta Research just learned that 82% of DATA SOURCES subscribers use the directory to telephone potential vendors for more information, a presentation or a bid.

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Because DATA SOURCES delivers MIS/DP buyers in top companies who spend $1.1 million annually per department. And, these professionals count on DATA SOURCES three times a week.

Seventy-six percent of subscribers consult DATA SOURCES at the very beginning of the purchasing process, when the need for the product is confirmed at their company. Three-quarters also use DATA SOURCES to evaluate alternative products and to compose a vendor list.

Isn't this the right time to remind them who you are?

But you have to make the first call yourself. To the publisher, Kim Norris, at 212-503-5864.

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Get the Most From Your Software.

Put a PC-DocuRef™ Software Quick Reference Guide on your keyboard

Today's PC software is more powerful than ever. But, with that power often comes added complexity. Now, there's an easy way to increase your productivity and get more from your software. PC-DocuRef software quick reference guides from SMA provide a fast command reference that speeds software use. Plus, all PC-DocuRefs contain helpful tips, examples and warnings that help you extend your knowledge of the software. You'll use more of the power built into the program.

Remember Commands Easily

If, like many people, you use several software packages in your job, you could have more than 1,000 commands to remember. With a PC-DocuRef on your keyboard, you have an easy-to-use memory aid right at your fingertips.

Save Time and End Frustration

You'll save hours of time because you won't have to dig through cumbersome manuals for commands. PC-DocuRefs are functionally organized and fully color-coded to help you find commands fast.

Learn New Commands and Functions Quickly

A PC-DocuRef quick reference guide can help you learn and use PC software faster and with more confidence. You'll master new software more easily while you discover powerful, untapped features in familiar programs.

Fits any Keyboard

PC-DocuRef attaches to any keyboard, including portables and laptops, using velcro-like fasteners. It's easy to put on and easy to switch to another PC-DocuRef when you change programs.

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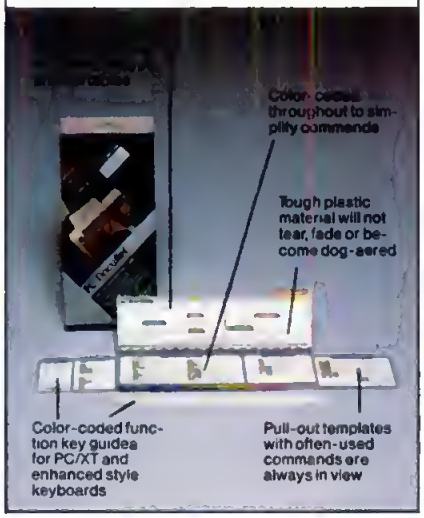
The unique PC-DocuRef design makes it the perfect software companion. Special pull-out templates keep often-used commands in view at all times. The tabbed pages are organized with the most important commands up front for fast reference. There's even a separate function key template for IBM PS/2 and Enhanced keyboards.

Here's why PC-DocuRef is the best software quick reference.



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PC MAGAZINE

THE SHOWCASE FOR PRODUCTS AND SERVICES IN THE MS DOS MARKET . . .

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PC MAGAZINE MARKETPLACE

HARDWARE/ ADD-ON BOARDS

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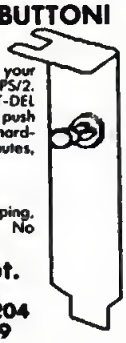

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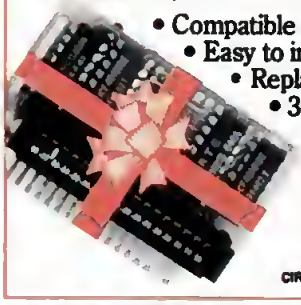

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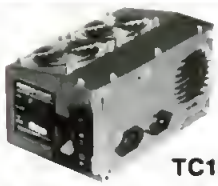

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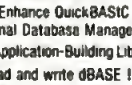

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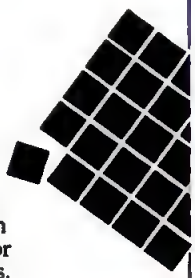

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THE CHEAPEST ATs EVER If you're like most people, you probably assume that if you want the power of an AT, you'll have to pay a steep price. But with the proliferation of AT clones in the marketplace, manufacturers looking for a competitive edge have slashed prices. You can now find an AT compatible with a monochrome monitor and hard disk for well under $2,000—some from mail-order companies, some from name-brand vendors. In our reviews, we test 21 machines to find the brightest bet at a bargain price.

VGA COMPATIBLES The introduction of the IBM PS/2 line with its built-in VGA display awed computer users everywhere with the most colorful images ever seen on an IBM-type display. It also launched a race among manufacturers to bring out their own display adapters that would be compatible with this new standard. Winn L. Rosch reviews the first wave of products to cross the finish line.

LOGITECH VS. MICROSOFT The introduction of two new mice from Logitech and Microsoft is changing the face of the mouse market. The new Logitech C-7 mouse offers three buttons and 320-dpi resolution. And the latest Microsoft Mouse, with its sleek ergonomic design, virtually eliminates hand fatigue.

CONNECTIVITY Univation is trying to carve out its niche in the LAN marketplace with the first high-end network operating system to offer database service. We review just how well Univation's *LifeNet* implements third-generation networking capabilities.

MODEST SPREADSHEETS *Lotus 1-2-3* is the first thing that comes to most people's minds when they hear the word *spreadsheet*. But it might not be worthwhile to fork over big bucks for a powerhouse spreadsheet like *1-2-3* and its clones if your spreadsheet needs are modest. The 14 packages we review here all cost less than $200 and are geared toward users with less-demanding spreadsheet applications.

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- s. ☐ Mini(s)

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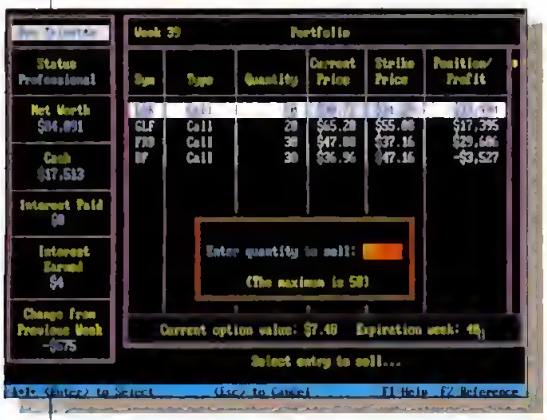

Millionaire II's slick user interface makes it easy to take a $33,000 profit in Lockheed one week before the call options expire.

GAMES

Safe Stocks: Millionaire II Gives You All the Action and None Of the Risk

BY DONALD TRIVETTE

Who among us hasn't dreamed about running a few hundred dollars into a cool million? About cornering Ford or taking over GM? *Millionaire II*, from Britannica Software, lets us play our mogul emotions for all they're worth. Safely.

Millionaire II is based on the ups and downs of real companies taken from 91-week periods over the last decade. The companies are divided into five groups: the automotive, computer, energy, aerospace, and food industries. In each group are three companies, major hitters all, including Ford, Digital Equipment Corp., Texaco, Lockheed, and General Mills.

The play begins with you as a novice, holding $10,000 in your hot, sweaty hands. You have the ability to buy and sell common stocks. As your net worth increases you gain status and privileges: as an investor, you can buy on margin; as a speculator (once you've accumulated at least $18,000), you're allowed to purchase call options; if you make it to professional, you can buy put options; and anyone who reaches the zenith of broker (by amassing $100,000) can do all of the above plus sell short.

As you advance from week to week, the program displays charts to show how the economy and particular issues are faring; for investors who consider charts just so much art work, *Millionaire II* also displays news blurbs for each period. "Auto sales expected to rise in next quarter" and "Aerospace faced with a slowdown" are typical of the subtleties. From watching the charts and reading the news, you plan your attack.

Millionaire II differs from the old *Millionaire I* in several respects. The new version is in color, allows two players to compete with one another, has an improved command structure, and is faster. It also has a few flaws. Since it's billed as a simulation, one wonders why the designers mixed real and fictitious stock symbols. For example, Ford is referred to as "FRD" instead of the proper "F." This could prove costly to anyone who assumes the game is accurate and then invests real money in the real FRD, Friedman Industries.

How did I do with my wad of bills? I clawed my way up until I got to the speculator level, and then I blew all my funds on call options that expired in the 40th week. I watched as my fortune increased to about $90,000 and then began to wane. In the 39th week I cashed in some options and let the others ride for the last week. A bad mistake.

In the 40th week the program automatically declared my options to have expired without giving me the chance to sell or convert them to stock. I felt cheated, and in real life I would have changed brokers, consulted my lawyer, called the SEC, and cried. Instead, I switched on the TV. Who wants to be a millionaire, anyway?

List Price: *Millionaire II*, $59.95. **Requires:** 256K RAM, one disk drive, DOS 2.0 or later. Copy protected. Britannica Software, 185 Berry St., San Francisco, CA 94107; (415) 546-1866.

CIRCLE **652** ON READER SERVICE CARD

How to Dispense Cross-Checks, High Sticks, And Slap Shots Without Getting Bruised

BY GUS VENDITTO

Hockey is not a sport for the meek. Few hardy souls ever master ice skating on an empty rink, let alone try to weave through a swarm of hostile, heavily padded opponents while guiding a 1-inch-thick rubber disk down the ice. Watching hockey from the stands is often more of a challenge; if the brawling hometown fans don't get you, their beer splashes will.

Mindscape has eliminated the negatives and come pretty close to capturing the mental excitement of the game in *Superstar Ice Hockey*. It provides an arcade level of control in basic hockey maneuvers and lets the more ambitious fan take control over a team, generate a lineup, enter into trades with others in the league, and recruit from the minor leagues. It makes excellent use of CGA graphics.

Most people will be content to enjoy basic maneuvers one-on-one with the game: trying to slip a cross-check past the referee and faking out the goalie with deft joystick maneuvers. One adjustment you will want to make to the game: choose to go to training camp and improve your team to the max. If you do, you still won't be able to outskate the game's center, but at least he won't skate circles around you. And don't bother trying to play without a joystick or on a PC running faster than 4.77 MHz. You'd be better off going one-on-one with Wayne Gretzky.

If you like to watch hockey, you'll love this game.

List Price: *Superstar Ice Hockey*, $39.95. **Requires:** 256K RAM, one disk drive, CGA or EGA, DOS 2.0 or later. Joystick recommended. Copy protected. Mindscape Inc., 3444 Dundee Rd., Northbrook, IL 60062; (312) 480-7667.

CIRCLE **651** ON READER SERVICE CARD

With a little practice, you'll be a competitive player, but Superstar Ice Hockey *won't let you outskate the game's center.*

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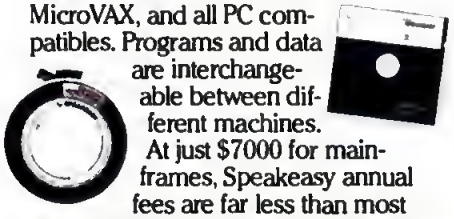

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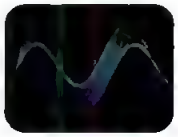

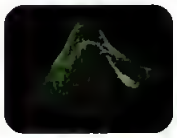

Call Steve Sogar today at 1-800-227-1209 to discuss your problem-solving needs. Mainframe versions are available for a 2-month free trial; micro versions come with a 2-month money back guarantee.

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Music
(continued)

tics of each note's beginning, middle, and end).

The Ad Lib system can keep you glued to your PC for hours as you develop and change instrument sounds and musical compositions. But its limitations are clear.

This is not a package for the serious musician looking for a performance instrument. You can't play the system in real time, and while it does accept input from a MIDI keyboard (see the sidebar "MIDI: Musical Information Sharing" for a description of the MIDI standard), it takes such input only one note at a time and it won't drive a MIDI device.

If what you want is a way to learn about and experiment with synthesized music, the Ad Lib system could be for you.

Sophisticated Sounds

Far more sophisticated is the $795 Music Magic Synthesizer, which is manufactured by Music Magic Co. This full-length add-in card generates 16 simultaneous voices—twice as many as IBM's Music Feature board—and multiple cards can be installed to sound as many as 64 notes at once.

Music Magic's software organizes defined sounds, up to a total of 16, in "slots." A slot is simply the sum of the parameters that define an individual sound. Each slot can have its own tone color, volume, stereo position, and transposition—essentially, it's what is normally thought of as a voice plus electronic effects.

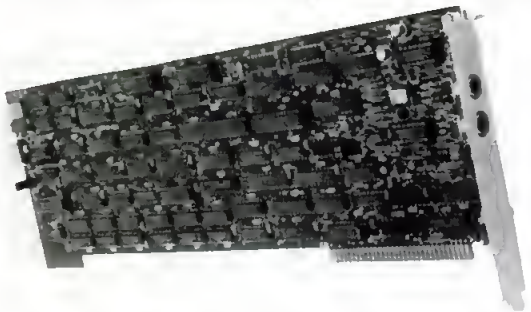
Each slot has its own MIDI channel and can play its own polyphonic or monophonic musical line. Or several slots can be assigned to the same MIDI channel for layered effects. Each slot can be assigned special effects like echo, special tunings, and glide.

A Music Magic "ensemble" is a collection of 16 slots. Effectively, an ensemble is one complete, programmed implementation of Music Magic, with up to 30 defined instrument sounds, plus the required MIDI information. Entire ensembles can be stored and recalled as needed, so the user can have several completely programmed synthesizer settings available.

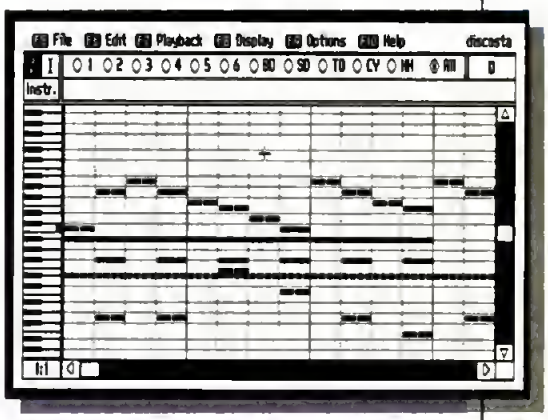
To generate the sounds that you hear, Music Magic uses a process called additive synthesis. This method adds oscillator-generated harmonics until the desired timbre is reached.

Music Magic's instrument definer gives very flexible control over sound generation. You can combine the output of up to four oscillators to form a single instrument sound.

The board can also reproduce sampled sounds, which are stored in memory. It can't be used to capture sound samples, so the user is limited to the samples provided by Music Magic.



The Music Magic Synthesizer card packs the power of a full-featured digital synthesizer onto a single full-length add-in card. The two phono jacks at the rear of the board connect it to external amplification. Audio output from the board is not sufficient to drive a speaker or headphones without additional amplification.



A menu called the "slot" page displays settings for The Music Magic Synthesizer card. Each slot is a group of characteristics, including tone color, volume, and special effects. Users can store settings for up to 16 such slots.

The card offers full MIDI support, which means that you can use the Music Magic board as part of an integrated MIDI system. MIDI-compatible keyboards, guitar controllers, drum machines, and other equipment can interact with the Music Magic board. I used a Roland Juno 106 keyboard as a controller for the Music Magic board, but if you don't have a keyboard you can use your PC keyboard to trigger sounds instead.

Users must supply amplification, however, because the line outputs from the Music Magic card aren't sufficient to drive speakers or headphones. A typical home stereo does the job well.

Overdub up to 48 Tracks

The Music Magic software includes very complex and flexible recording capabilities. As with a multitrack recorder, you can record an initial track, then overdub additional parts, up to a total of 48 tracks. So you can start by defining instruments, then lay down tracks with the recorder until you have a complete composition. You can do all of this within Music Magic; it can function within a MIDI system or as a complete system unto itself.

The Music Magic Synthesizer is a serious tool for performance, composition, or exploration of music. But its complexity and considerable capabilities make it a somewhat formidable product for the beginner to approach. The documentation breaks things down to a step-by-step process, however, and makes for fairly smooth going.

If you are looking for a powerful tool, the Music Magic board could be it. If you are looking for an educational, interesting way to find out about music, the Ad Lib Personal Computer Music System is a more inviting and affordable choice. Either one will bring you insight into music in general and the new world of synthesized sound in particular.

List Price: The Ad Lib Personal Computer Music System, $245. *Instrument Maker*, $50. **Requires:** 256K RAM, two floppy disk drives, graphics adapter, half-length slot, headphones or powered speaker, DOS 2.0 or later. Software not copy protected. Ad Lib Inc., 50 Stanford St., Boston, MA 02114; (800) 463-2686.

CIRCLE **653** ON READER SERVICE CARD

List Price: The Music Magic Synthesizer, $795. **Requires:** 320K RAM, two disk drives, graphics adapter, expansion slot, external amplifier and speaker, DOS 2.0 or later. Music Magic Co., 180 Basswood, Cleveland, OH 44022; (216) 247-8818.

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AFTER HOURS

Music
(continued)

the musical characteristics of a real trumpet, but no one will be fooled into thinking you have Miles Davis hidden in your PC.

The synthesizer is accessed and controlled by a program called *Visual Composer*. As its name suggests, this software is where you generate and record the music that will be played back by the synthesizer. The package's *Windows*-like interface features pull-down menus, dialog boxes, and full mouse support.

Visual Composer's greatest strength is that it does away with traditional musical notation. Instead of staves and clefs, *Visual Composer* presents a sort of musical spreadsheet. Notes are entered, either from the keyboard or with a mouse, as dashes on a grid.

Pitch varies along the *y*-axis of the grid; the closer the dash is placed to the top of the screen, the higher the note will be.

The *x*-axis represents time. So, the longer the dash, the longer the note will sound.

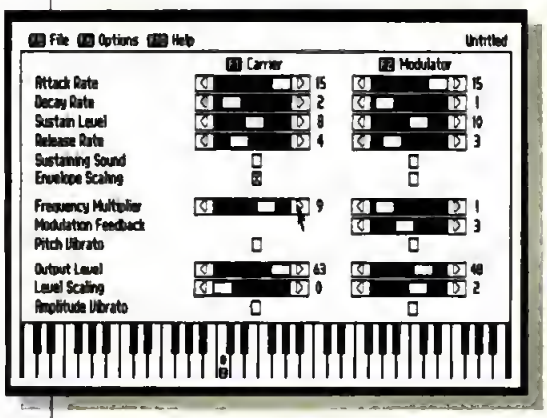
This system makes visualizing written music much easier for the neophyte composer. Intervals—the distances between pitches—are clearly visible on the grid.

If you don't have the benefit of musical training, you can develop a sense of which notes sound good together and which combinations set your teeth on edge by trial and error. And since *Visual Composer* presents a graphic of a piano keyboard along the left side of the screen, notes can also be thought of in a more traditional way.

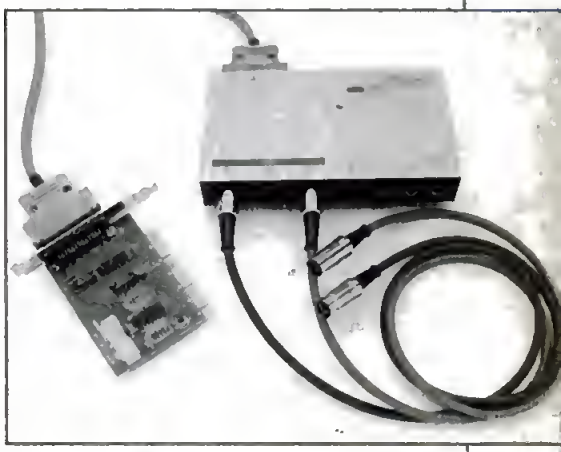
Rhythms, too, are easier for the untrained to deal with in *Visual Composer*. Gone are the arcane dotted notes and squiggly rest symbols of conventional notation.

Instead, the relative lengths of notes reveal their time values. A dash that is twice the length of another dash will sound for twice as long.

Visual Composer also provides access to the preconfigured instrument sounds that come with the Ad Lib system. You can write music for up to 11 simultaneous sounds, or "voices." Up to six melodic voices can be used with as many as five percussion sounds, or up to nine melodic voices can be used without percussion.



Instrument Maker is a $50 add-on to the Ad Lib system. Scroll bars and check boxes are used to modify FM synthesis parameters. The effect of a change can be tested by pointing to a note on the keyboard representation on the screen.



Roland's MPU-401 MIDI processing unit connects a MIDI-compatible keyboard to The Music Magic Synthesizer. The MPU-401 attaches to the PC via a separately available bus card.

For the rank beginner, Ad Lib includes a program called *Juke Box* as a way to make some initial noise. The program's main menu lists prerecorded songs that have been stored as files. Tapping a number key plays the tune assigned to that key. Once you get as far as creating your own masterpieces, they too can be stored and replayed in *Juke Box*.

To help you get the most out of the Ad Lib system, the company includes a book called *Composition Projects #1*, which is a supplement to the basic documentation. The book leads you step by step through a sample composition and helps you develop currency with the main techniques of *Visual Composer*. It also introduces basic concepts of musical structure.

Composition Projects #1 is a very useful adjunct to the main documentation, which is sometimes unclear and confusing.

There is a lot you can do with just the basic Ad Lib system, but an additional investment of $50 for a software package called *Instrument Maker* gives you much greater control over the actual sound of the synthesizer.

Instrument Maker lets you modify the parameters that define the Ad Lib synthesizer's sounds. When you bring up the program, its main screen presents a list of sound parameters. Next to each parameter is either a scroll bar or an on/off check box that lets you adjust the parameter.

The program starts you off with a basic piano sound, and you modify it with the scroll bars until it takes on the timbre that you want. Among the parameters that can be adjusted are attack, sustain, decay, and release for the output of each of the synthesizer's two operators (for the uninitiated, these parameters govern the characteris-

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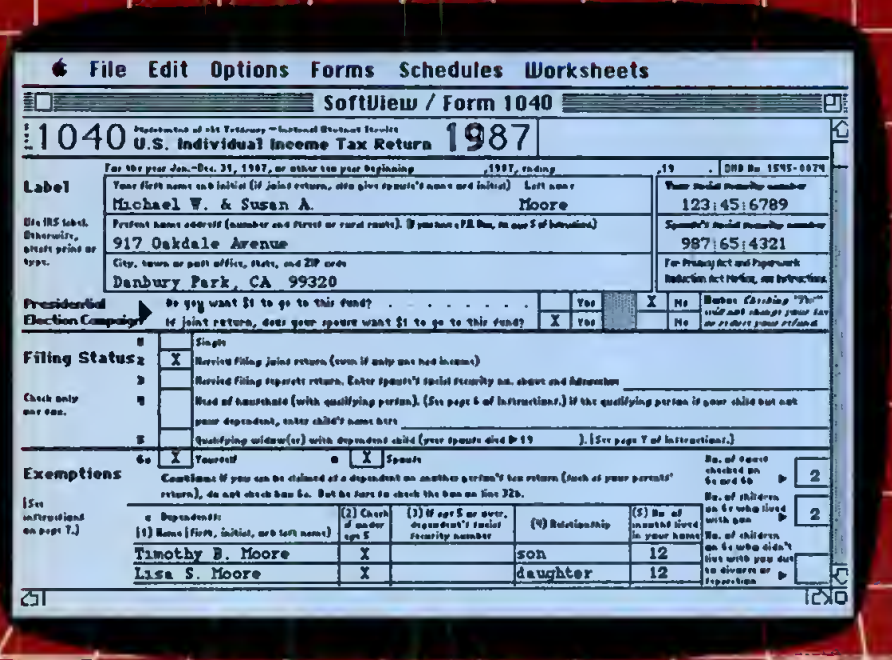

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MUSIC

Make Your Own Melodies: Systems for Amateurs and Virtuosos

BY JONATHAN MATZKIN

Electronics has changed the music around you at least as much as it has altered your workplace. Flip on your radio and you'll hear electronic sounds in every context, from the cutting edge of classical music to the beating pulse of Top 40 pop.

So what's all that got to do with the PC you use to write dry memos and plan complex budgets? Probably the only sound you customarily get from your CPU is an obnoxious beep when you do something *Lotus 1-2-3* doesn't like.

But with the proper add-on equipment, your workaday PC can become an outlet for your musical urges. It can function as a full-featured synthesizer that will create sounds that leave many dedicated instruments in the dust. Or it can be a blank sonic canvas that records musical compositions limited only by your imagination.

Perhaps most important, your PC can teach you about music. Electronic synthesis brings you right to the sounds and rhythms, even if you flunked piano and never managed even the simplest chords on a guitar. You can proceed directly to the concepts behind music without wading through the discipline of learning a traditional instrument.

Other hardware formats (notably Apple, Atari, and Commodore) have offered more choices to the musician in the past. But all that is changing nowadays.

Choose Your Level

The Ad Lib Personal Computer Music System, from Ad Lib, is an inexpensive introduction to the hows and whys of music. The $245 combination hardware/software package includes a board-level synthesizer for your PC. It also has a software package that allows an absolute beginner to write and play back music.

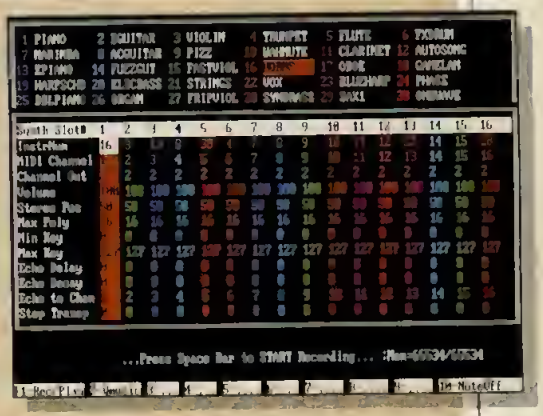
The Music Magic Synthesizer, from Music Magic Co., is less friendly to the novice, but the $795 package merges a much more powerful digital synthesizer with the PC.

Novice Sounds

The Ad Lib system's synthesizer is on a half-card that installs in an expansion slot. The card has outputs that will drive a powered speaker or Walkman-type headphones, either of which must be provided by the user.

The synthesizer offers a wide variety of different timbres to choose from. The sounds are generated by FM synthesis and vary in their realism. Some sounds, like the piano and organ timbres, are instantly recognizable and quite close to their "real" counterparts.

The trumpet and other brass sounds, on the other hand, don't sound anything like their namesakes. The trumpet has some of



The Ad Lib Personal Computer Music System dispenses with traditional musical notation. Notes appear as dashes on a grid and can be entered via keyboard or mouse. Each line above represents a different musical voice.

AFTER HOURS INDEX

A Musical Interlude
Hands-on reviews of the Music Magic and Ad Lib systems
Millionaire II
Playing with a fortune
Ice Hockey
Build a team or play a one-on-one game

MIDI: Musical Information Sharing

Like a communications protocol, MIDI is a standard that allows hardware and software from different manufacturers to work together in a harmonious, flexible system.

Any MIDI-compatible instrument can be interfaced with any other instrument or device that supports the MIDI communication protocol. So a variety of instruments, from keyboard-based synthesizers to MIDI guitar controllers and digital samplers, can be linked and used together. These instruments can share information about pitch, timbre, loudness, and other factors that define the sounds that you hear.

MIDI gives musicians great control over multiple instruments, since a single MIDI device can be used to control other MIDI devices. A live performer can program a sequence of events involving a number of MIDI instruments, and then trigger the sequence from a remote device like a keyboard. For example, a musician could use MIDI interfaces to tie together a keyboard-based synthesizer, a drum machine, and a digital sampling unit. The musician could control the drum machine—choosing beats and turning it off and on—from the primary keyboard. Sounds produced by the digital sampler could also be accessed from the keyboard.

In testing The Music Magic Synthesizer, we used a Roland Juno 106 keyboard synthesizer and an IBM PC-XT; they were linked by a Roland MPU-401 MIDI processing unit.

The Ad Lib system is semi-MIDI-compatible; it can receive input from MIDI devices but doesn't generate MIDI signals.

—Jonathan Matzkin

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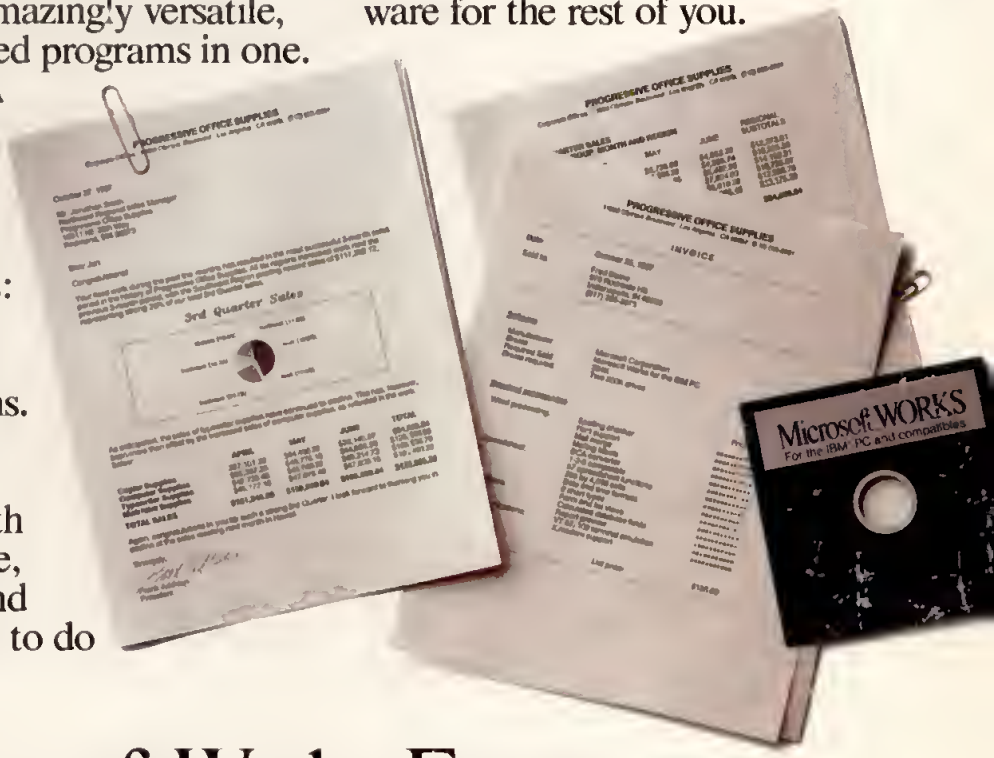

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